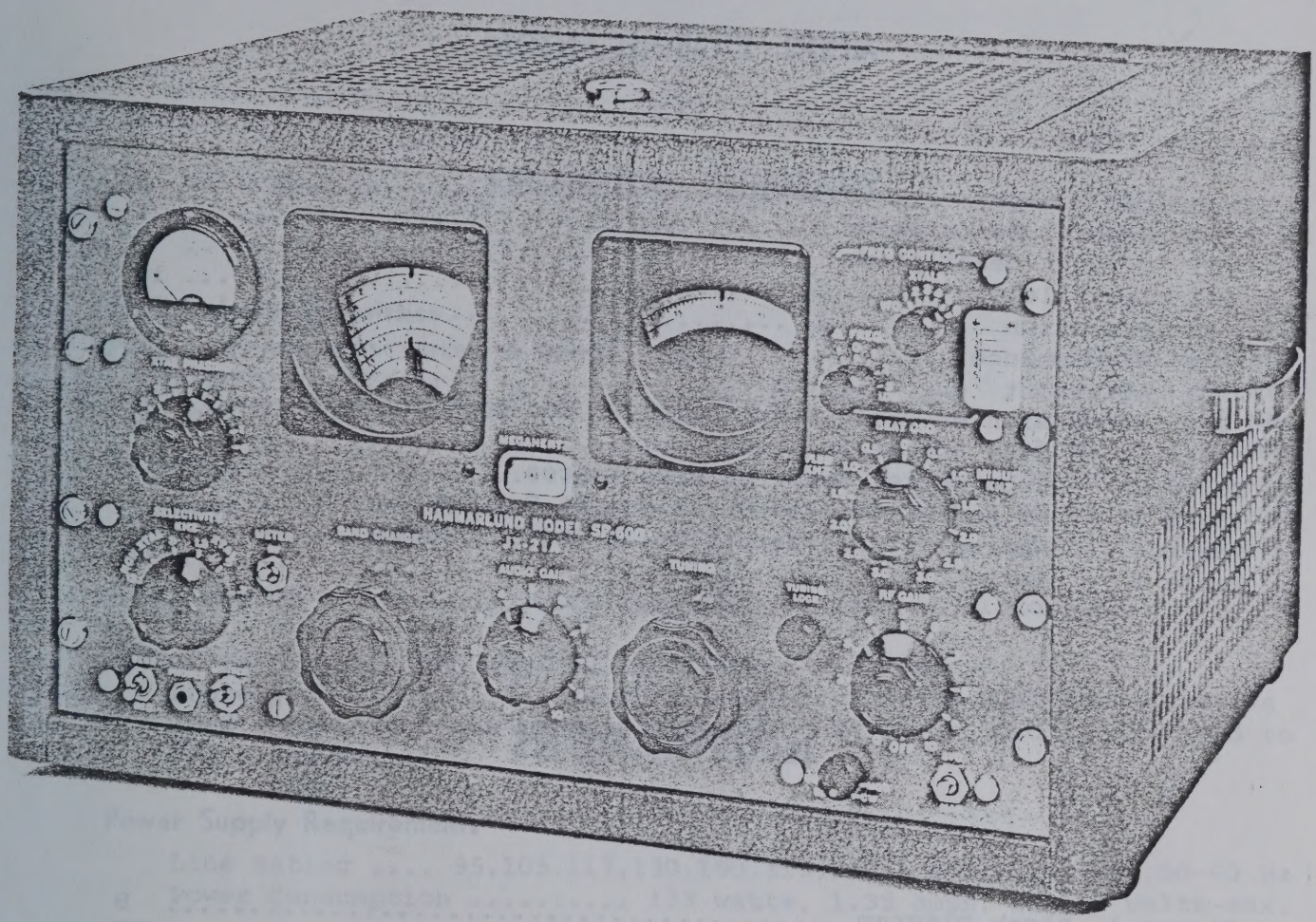


MODEL SP-600-JX21A

TABLE OF CONTENTS

TITLE	PAGE
Technical Summary	3
I General Description	5
II Circuit Description	7
III Installation	10
IV Operation	11
V Maintenance	16
VI Alignment	24
VII Conversion of Table Model Receiver for Rack Mounting	30
Table 1 - Tube Socket Voltages	22
Table 2 - Tube Socket Terminal Resistances	23
Table 3 - RF and HF Oscillator Alignment Frequencies	27
Table 4 - Approx. Signal Inputs at IF and AF Stages	27
Table 5 - Parts List	31

ILLUSTRATIONS

Figure 1	Block Diagram	9
Figure 2	Location of Tubes and Adjustments	28
Figure 3	Audio and Overall Fidelity Curves	28
Figure 4	Selectivity Curves	29
Figure 5	Front View of Receiver	36
Figure 6	Rear View of Receiver	37
Figure 7	Top View of Receiver	38
Figure 8	Bottom View of Receiver - Tuning Unit Shield Removed	39
Figure 9	Bottom View of RF Tube Platform	40
Figure 10	Bottom View of Frequency Control Unit	41
Figure 11	Product Detector Assembly	42
Figure 12	Connection Diagram - Tuning Unit	43
Figure 13	Connection Diagram - Frequency Control Unit	44
Figure 14	Connection Diagram - Receiver Chassis	45
Figure 15	Circuit Diagram of Receiver	47

GENERAL PURPOSE COMMUNICATIONS RECEIVER

MODEL SP-600-JX21A

TECHNICAL SUMMARY

Electrical Characteristics

FREQUENCY RANGE - Total 6 Bands	.54 to 54.0 MHz
Band 1	.54 to 1.35 MHz
Band 2	1.35 to 3.45 MHz
Band 3	3.45 to 7.40 MHz
Band 4	7.40 to 14.8 MHz
Band 5	14.80 to 29.7 MHz
Band 6	29.70 to 54.0 MHz

POWER OUTPUT - 2.0 Watts, with less than 10 percent distortion.

Output Impedance - 600 ohms balanced split windings.
Phone jack winding; delivers 15 milliwatts to an 8000 ohm resistive load, when the audio output to the 600 ohm power load is adjusted to 500 milliwatts.

Power Supply Requirements

Line Rating .... 95,105,117,130,190,210,234 & 260 volt taps,50-60 Hz
Power Consumption ..... 133 watts, 1.35 amps. at 117 volts-max.

Tube Complement—total 22

RF, IF and BFO Amplifiers	7 - 6BA6
HF, 2nd. Conversion and BFO Oscillators	3 - 6C4
Crystal Controlled HF Oscillator	1 - 6AC7
Mixers	2 - 6BE6
Detector, "C" Bias Rectifier and Noise Limiter & Meter Rectifier	3 - 6AL5
AF Amplifier and IF Output	1 - 12AU7
Power Output	1 - 6V6GT
Rectifier	1 - 5R4GY
Voltage Regulator	1 - 0A2
Product Detector	1 - 12AU7
Carrier Oscillator	1 - 12AT7

Mechanical Specifications

Rack Model - Dimensions; 19 inches wide, 10½ inches high and 16½ inches deep from rack mounting surface. Weight 66 lbs.

Table Model- Dimensions; 21 3/8 inches wide, 12 3/4 inches high and 17 1/8 inches deep. Weight 87 ½ lbs.

Performance Data— (approximate values-taken on a sample receiver)

Sensitivity is 2.3 microvolts, or better, throughout the entire frequency range, for a signal to noise ratio of 10 db, at 20 milliwatts output and with the RF Gain Control at maximum.

Image rejection ratios are better than 74db throughout the frequency range.

The IF rejection ratio at 600 kHz is 2700 to 1.

The AVC action will maintain the output constant within 12 db when the input is increased from 2 to 200,000 microvolts.

GENERAL PURPOSE COMMUNICATIONS RECEIVER

I

GENERAL DESCRIPTION

The SP-600-JX-21A is a 22 tube Radio Communications Receiver with self contained power supply.

The receiver is supplied in either a well ventilated steel, table model cabinet finished in dark grey to complement the lighter grey front panel or for mounting in a standard 19 inch relay rack.

The self contained power supply is designed for operation from a single phase, 50 to 60 hertz alternating current power source. The power transformer primary is provided with taps covering a line voltage range from 90 to 270 volts. The power consumption is 133 watts.

The receiver is suitable for either headphone or loudspeaker reception of AM radio telephone, CW telegraph, AM MCW telegraph, upper and lower SSB signals and for diversity applications.

The standard model provides continuous coverage over a frequency range from 0.54 to 54.0 megahertz in six bands. The large easily operated band change control knob, on the front panel, selects the desired frequency band and a band indicator visible through a small front panel window indicates the frequency band in use. This control also aligns the dial frequency indicator with the proper dial scale.

In addition to the frequency scales, the main dial has an arbitrary scale which in conjunction with the vernier dial provides continuous expanded scales over each frequency band for extremely accurate logging and resetability.

The single tuning control is large and of special design to permit maximum traverse speed as well as exceptional operating ease. It controls both the main and vernier dials. An anti-backlash gear train provides extremely close calibration accuracy and completely accurate resetability. A tuning lock provides positive locking action without affecting the frequency setting.

The tuning ratio from the tuning control to the main dial is 50 to 1 and the ratio from the vernier dial to the main dial is 6 to 1.

Two stages of radio frequency amplification are provided on all bands. Single conversion is used for signal frequencies up to 7.4 mHz and double conversion, employing a crystal controlled oscillator, for signal frequencies above 7.4 mHz. Four stages of IF amplification, detector and AVC rectifier, noise limiter and meter rectifier, beat frequency oscillators and buffer amplifier, IF output, Product detector, AF amplifier and output power stage are provided.

The frequency control unit provides for fixed channel crystal controlled operation on any six frequencies within the range from .75 to 54 mHz. Front panel controls permit the selection of the normal high stability continuously variable tuning or either of the six selected fixed frequency signals. For crystal controlled fixed channel operation it is only necessary to set the dial to the signal frequency, switch to the crystal frequency desired and tune with the delta frequency control. These crystals are not supplied with the receiver, but may be purchased on special order from THE HAMMARLUND MANUFACTURING COMPANY INCORPORATED specifying the signal frequency for which each is to function.

The noise limiter circuit effectively limits the interference from ignition systems or other sources of pulse type noise. The limiter switch permits optional use of the limiter.

The antenna input circuit is designed for use with a balanced line. The input impedance is nominally 100 ohms. The receiver may also be operated with a conventional single wire antenna.

The product detector permits intelligible reception of sideband signals and CW signals. Crystal oscillators are used for carriers in the product detector for sideband reception, and the BFO output is injected into the product detector for CW reception.

The audio output circuit is designed for a 600 ohm load or line and is provided with a four terminal split winding for balanced load operation. Maximum power output is approximately 2.0 watts. The headphone circuit when referred to an 8000 ohm load provides signals attenuated approximately 15 db below the 600 ohm power output.

The send receive switch desensitizes the receiver but leaves the power on to provide for instant reception between transmission periods.

Radiation is negligible and complies with requirements for shipboard operation and for multi-receiver installations.

Frequency drift after a 15 minute warm up period, ranges between .001 percent and .01 percent of frequency depending on the frequency used. This is a very unusual degree of frequency stability for variable tuned HF oscillators and closely approaches crystal stability.

The selectivity control provides three degrees of crystal and three degrees of non-crystal selectivity ranging from sharp (.2 kHz) to broad (13.0 kHz). The crystal filter embodies the same circuit features that have proved so effective and desirable in Hammarlund Super Pro Receivers, incorporated in an improved mechanical design.

II

CIRCUIT DESCRIPTION

GENERAL - The circuit is shown schematically in Figure 14. A block diagram, Figure 2, is provided to more clearly show the arrangement and functions of the various circuit sections. The location of the various tubes is shown in Figure 3. The circuit, for single conversion, used for signal frequencies up to 7.4 mHz consists of two stages of RF amplification V-1 and V-2, First Mixer V-5, First Heterodyne Oscillator V-4, four stages of IF amplification V-7, V-9, V-10 and V-11, Detector and AVC rectifier V-14, Noise Limiter V-15, Beat Frequency Oscillator V-13, IF output and AF amplifier V-16-A and V-16-B, Output Power stage V-17 and the Power Supply system which includes B Power Rectifier V-19, C Bias Rectifier V-20 and Voltage Regulator V-18, Product detector V-221 and Carrier Oscillator V-222.

In the circuit for double conversion, used for signal frequencies above 7.4 mHz, the Second Mixer V-6 and Second Heterodyne Oscillator V-8 are substituted for the Gate tube V-7.

INPUT COUPLING - The antenna coupling is designed to provide optimum coupling from a 100 ohm transmission line. A balanced doublet or straight wire antenna may be used.

RF AMPLIFIER - An ingeniously designed rotary turret is employed to change bands and to place the coil assemblies of the RF amplifier V-1 and V-2, Mixer V-5 and First Heterodyne Oscillator V-4 stages directly adjacent to their respective sections of the four gang tuning capacitor and their respective tubes. This assures maximum sensitivity at high signal to noise ratio.

FIRST HETERODYNE OSCILLATOR - (VARIABLE V-4) - The rotary turret band change switch, advanced design of the four gang, twin section, variable tuning capacitor and rugged construction throughout, provide frequency stability and dial calibration accuracy to a previously unattained degree.

FIRST HETERODYNE OSCILLATOR - (CRYSTAL CONTROLLED V-3) - For services requiring extremely stable, fixed frequency operation, a crystal controlled high frequency oscillator is provided. Instant changeover from variable to crystal controlled oscillator with a choice of six crystal positions, is effected by a front panel control. A second front panel control permits adjustment of the crystal oscillator frequency over a plus or minus .005 percent range.

INTERMEDIATE FREQUENCY AMPLIFIER - Single conversion to 455 kHz is employed for signal frequencies below 7.4 mHz. There are four stages of IF amplification incorporating the Hammarlund patented crystal filter circuit. Six positions of selectivity provide 6 db bandwidths of .2, .5, 1.3, 3, 8, and 13 kHz. On the three narrower bandwidth positions, the crystal filter is in operation. The crystal phasing control provides extreme selectivity for the high attenuation of closely adjacent interfering signals.

Double conversion is employed for signal frequencies above 7.4 mHz. The signal is heterodyned to 3.955 mHz by the First Mixer V-5 and Heterodyne Oscillator V-4 or V-3 for high image rejection. The 3.955 mHz signal is then heterodyned to 455 kHz by the Second Mixer V-6 and the 3.5 mHz Fixed Crystal Controlled Oscillator V-8, for selectivity.

DETECTOR AND AVC - The V-14 tube is used as a high level Detector and AVC Rectifier. The AVC circuit is provided with separate time constants for CW and MCW operation. AVC and Diode output terminals provide for connections in diversity applications.

BEAT FREQUENCY OSCILLATOR - The beat frequency oscillator employs a high capacity Colpitts circuit which gives a high order of frequency stability and minimizes oscillator harmonics. The beat frequency Oscillator V-13, is coupled into the Product detector circuit through Buffer Amplifier V-12, which eliminates oscillator lock-in and permits variation of the beat oscillator injection by means of a control located on the rear of the chassis. A front Panel control varies the audio beat frequency, from zero beat to plus or minus 3 kHz.

NOISE LIMITER - The noise limiter circuit V-15, limits the noise interference from ignition systems or other sources of pulse type noise. A separate control switch S-6, permits optional use of the limiter on any mode of operation when pulse type interference is present.

PRODUCT DETECTOR - The product detector tube, V-200, mixes the intermediate frequency with a fixed carrier for sideband and CW reception. The crystal oscillator V-201, is used in single sideband reception. For USB reception a 456.500 kHz crystal is used , and a 453.500 kHz crystal is used for LSB reception. The BFO is fed into the product detector through a buffer amplifier, V-12, for CW reception.

AUDIO FREQUENCY AMPLIFIER - A resistance coupled amplifier triode V-16-B, amplifies the audio frequency signal from the detectors.

AUDIO OUTPUT - The audio output tube V-17, is transformer coupled through a split, balanced winding to deliver 2.0 watts undistorted output to a 600 ohm load. The split balanced winding permits balancing of the direct current in the output circuit, as used for teletype or similar service. A separate secondary winding provides attenuated audio signal output for headphone operation. This winding will deliver an output of 15 milliwatts into an 8000 ohm resistive load when the 600 ohm power secondary is delivering 500 milliwatts to a 600 ohm resistive load.

IF OUTPUT - A cathode follower V-16-A provides a 70 ohm impedance source of intermediate frequency (455 kHz) to socket, SO-239, on the rear skirt of the chassis. A PL-259 plug and RG-11/U cable, not supplied, are used for this connection.

POWER SUPPLY - The power supply is an integral part of the receiver. It includes the B rectifier V-19 and the C rectifier V-20, together with their respective low pass filters and the Voltage Regulator V-18. The power transformer is provided with screw terminal primary taps, covering a power line source range of 90 to 270 volts, 50 to 60 hertz. The power transformer and filter components are protected by fuses in the primary and plate supply circuits.

TUNING METER - The tuning meter is used on AVC operation to indicate the accuracy of tuning and the relative strength of received signals. Depression of the Meter Switch converts the meter circuit for indication of output level in db from 6 milliwatts.

RF GAIN CONTROL AND POWER SWITCH - The RF gain control is provided for manual control of sensitivity to prevent overloading on strong signals when operating with the AVC-MANUAL switch in the "MANUAL" position. This control also operates when the switch is in the "AVC" position. The Power "ON-OFF" switch is operated at the counter-clockwise extremity of the RF gain control.

SEND-RECEIVE SWITCH - The send-receive switch desensitizes the receiver but leaves the power "on" to provide for instant reception between transmission periods.

CONVENIENCE OUTLET - A convenience power outlet is provided on the rear of the chassis for the connection of an accessory such as a lamp or electric clock.

RADIATION - Advanced design and shielding of the high frequency, second conversion crystal and beat frequency oscillators has reduced radiation to a negligible point so that interference of this nature, common in multi-receiver installations, is reduced to a minimum.

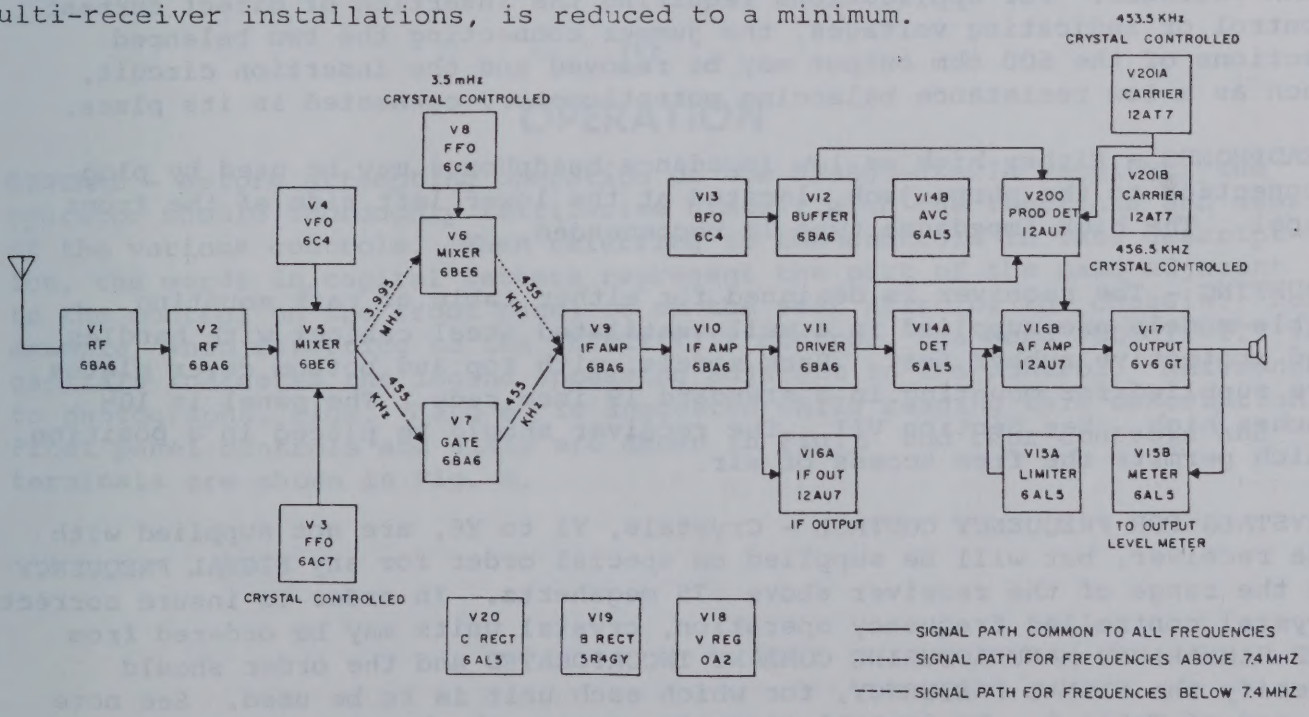


FIG. I BLOCK DIAGRAM

III
INSTALLATION

TUBES AND PACKING - After unpacking the receiver see that all tubes are firmly in their sockets and that any packing material is removed from the receiver.

POWER SUPPLY - Make sure that the primary tap lead at the bottom of the power transformer is connected to the tap which most nearly agrees with the 50 to 60 hertz power source voltage.

ANTENNA - The input impedance at the antenna socket, UG-103/U, is designed to match a 100 ohm transmission line. The angle plug adapter, UG-104/U, and connector plug, UG-102/U, supplied with the receiver, are for use with RG-22/U cable which should be used with a balanced antenna installation. If it is desired to operate with a single wire antenna, the antenna lead-in wire should be connected to one terminal of the connector plug and a ground lead should be connected from the other terminal of the connector plug to the ground terminal, which is adjacent to the antenna socket at the rear of the tuning unit.

SPEAKER - The speaker should be of the permanent magnet dynamic type and should include a speaker voice coil to 600 ohm line matching transformer for connection to the 600 ohm audio output terminals of the receiver. CAUTION: WHEN THE 600 OHM OUTPUT IS NOT USED, CONNECT A 600 OHM, 2 WATT RESISTOR TO THESE TERMINALS TO AVOID COMPONENT DAMAGE FROM HIGH TRANSIENT PEAK VOLTAGES. For applications requiring the insertion of direct current control or indicating voltages, the jumper connecting the two balanced sections of the 600 ohm output may be removed and the insertion circuit, such as a low resistance balancing potentiometer, connected in its place.

HEADPHONES - Either high or low impedance headphones may be used by plug connection to the phone jack, located at the lower left side of the front panel. The high impedance type is recommended.

MOUNTING - The receiver is designed for either table or rack mounting. Table models are supplied in a well ventilated steel cabinet with handles and protective rubber feet. Rack models, with top and bottom cover plates are supplied for mounting in a standard 19 inch rack. The panel is 10½ inches high. See Section VII. The receiver should be placed in a position which permits the free access of air.

CRYSTALS FOR FREQUENCY CONTROL - Crystals, Y1 to Y6, are not supplied with the receiver, but will be supplied on special order for any SIGNAL FREQUENCY in the range of the receiver above .75 megahertz. In order to insure correct crystal controlled frequency operation, crystal units may be ordered from THE HAMMARLUND MANUFACTURING COMPANY INCORPORATED and the order should specify the SIGNAL FREQUENCY, for which each unit is to be used. See note at end of Table 5. To install crystals, loosen the knurled thumb screw on

top of the Frequency Control Unit, T34, and push the retainer spring assembly to the rear. Insert the crystal or crystals in the sockets, numbered 1 to 6. Bring the retainer spring assembly forward so that the springs press on top of the crystal holders and tighten the thumb screw. Mark the SIGNAL FREQUENCY for which each crystal was selected, in megahertz on the plastic chart provided for this purpose alongside the crystal switch, S2. Pencil or ink may be used and can be erased if it is desired to change these figures at any time. The numerals on the chart should be used so that they agree with the numerals on the crystal socket positions, which are also indicated by the crystal selector switch.

RELAY CONNECTIONS - If external relay operation for the send-receive function is desired, connection may be made by soldering a twin conductor cable to the terminals of the Send-Receive switch, S9. In this case S9 is left in the Send or open position.

AVC AND DIODE OUTPUT - Shunt connection to the AVC bus and series connection to the detector diode load are provided at the rear of the receiver for diversity applications. The Diode Output terminals are provided with a wire jumper connection when these terminals are not used for external connection.

IF OUTPUT - The IF Output socket, SO-239, at the rear of the chassis provides for connection in diversity, teletype or other applications where a source of 455 kHz, intermediate frequency is required. A PL-259 plug and RG-11/U cable should be used. This will provide an output of approximately 200 millivolts to a 70 ohm resistive load, with a normal sensitivity input of 2 microvolts signal.

CONVENIENCE OUTLET - The power outlet receptacle at the rear of the chassis may be used for operating an accessory, such as an electric clock or lamp.

IV
OPERATION

GENERAL - Before attempting operation of the SP-600-JX-21A Receiver, the operator should thoroughly familiarize himself with the functions and uses of the various controls. When referring to the controls in this description, the words in capital letters represent the part of the name adjacent to the control on the front panel or on the rear skirt of the chassis. For example, when referring to the SELECTIVITY control, the word SELECTIVITY in capitals indicates the legend appearing adjacent to the control. Reference to photographs, Figs. 5 and 6, is suggested while reading this description. Front panel controls and dials are shown in Fig. 5 and rear controls and terminals are shown in Fig. 6.

SELECTIVITY CONTROL - The SELECTIVITY control is a 6-position switch which selects three crystal and three non-crystal degrees of selectivity, ranging from extremely sharp for CW reception to broad for good fidelity MCW operation. The SELECTIVITY control knob indicates the 6 db bandwidth at each setting.

PHASING CONTROL - The XTAL PHASING control is a differential type, variable air capacitor. It permits adjustment of the crystal selectivity characteristic for high attenuation of closely adjacent channel interference on either side of the signal frequency.

RF GAIN CONTROL - The RF GAIN control varies the overall gain of the receiver. This control is operative in either position of the AVC-MAN switch.

POWER SWITCH - The power, or on-off switch is combined with the RF GAIN control. Complete counter-clockwise rotation of the RF GAIN control throws the power switch to the OFF position, as indicated on the panel.

AUDIO GAIN CONTROL - The AUDIO GAIN control varies the input voltage to the audio amplifier. This control is also operative in either position of the AVC-MAN switch.

PHONES JACK - The PHONES jack is a single circuit jack operating with the sleeve grounded and is suitable to receive any standard single circuit phone plug. It is in the circuit at all times and is connected to a separate secondary winding of the audio output transformer, which provides an attenuated signal for headphones. See Section III.

AUDIO OUTPUT - The AUDIO OUTPUT is available at the four screw terminal board at the rear of the chassis for connection to a 600 ohm load. See Section III.

NOISE LIMITER - The LIMITER control switches the noise peak limiter in or out of the circuit. This control is operative independently of any position of any other control. See Section II.

AVC-MANUAL SWITCH - In the AVC position the AVC-MAN switch applies automatic bias potentials to the controlled RF and IF amplifier tubes, thereby holding the audio output relatively constant over a wide variation in the strength of received signals. This minimizes the variation of output due to fading of the received signal and prevents blasting and overloading when tuning through signals of greatly different strength while traversing a frequency band. In the AVC position the RF Meter circuit is operative for indication of tuning resonance and relative strength of received signals. The RF GAIN control is operative on AVC operation, when necessary to control exceptionally strong signals or to reduce noise, but the RF meter is less effective when the RF GAIN control is below maximum setting. In the MAN position the AVC potential is removed from the controlled tubes and the gain of the receiver is manually controlled by the RF GAIN control.

USB-LSB-CW-MOD SWITCH - The USB-LSB-CW-MOD switch gives the operator a choice of the type of signal to be received. In the USB position a carrier oscillator, 1.5 kHz above the intermediate frequency, is switched into the product detector. In the LSB position a carrier oscillator 1.5 kHz below the intermediate frequency is switched into the product detector. In the CW position, a carrier from the beat frequency oscillator is injected into the product detector through a buffer amplifier, and an additional timing capacitor is switched into the AVC circuit to accomodate the AVC to slow keying. In the MOD position, product detection is switched out, and diode detection is switched in. Both carrier oscillators and the BFO are inoperative in the MOD position, and the conditions are established for either voice modulated or tone modulated signal reception.

BEAT FREQUENCY OSCILLATOR - The BEAT OSC control varies the tuning of the 455 kHz beat frequency oscillator over a range from zero beat to plus or minus 3 kilohertz.

BFO INJECTION - The BFO INJ control adjusts the cathode self bias of the beat frequency buffer amplifier, thereby determining the injection voltage to the product detector.

SEND-RECEIVE - The SEND-REC control is a single pole, single throw toggle switch. In the SEND position it desensitizes the RF amplifier, gate, second mixer and 3.5 mHz oscillator tubes during transmission periods.

TUNING CONTROL AND DIALS - The TUNING control rotates the main tuning capacitor as well as the main and vernier tuning dials. The main dial has six frequency band scales, calibrated in megahertz, and an arbitrary outer scale. The vernier dial has an arbitrary 0 to 100 scale. The numeral under the upper or fixed pointer of the main dial indicates the number of complete revolutions that have been made by the vernier dial at any setting. Thus, if the pointer for the outer scale of the main dial indicates over the figure 4 and the vernier dial indicates 87.6, the reading to log for this setting is read, 487.6. This precise mechanical vernier system divides the rotation of the main dial over each frequency band into approximately 600 vernier divisions, with one-half division calibration points. Since it is easy to estimate one-tenth divisions on the vernier scale, this divides each frequency band into approximately 6000 readable settings. This permits extreme accuracy in the logging and resetting of stations.

TUNING LOCK - The TUNING LOCK, located to the right of the TUNING control, provides a positive lock for the tuning mechanism without affecting the frequency setting when it is desired to prevent accidental shifting of the tuning.

BAND CHANGE - Each revolution of the BAND CHANGE control turns the turret, containing the RF and HF Oscillator coil, trimmer and switch contact assemblies, from one frequency band to the next. The turret has no stops and may be turned in either direction desired. A positive detent mechanism assures correct location of the various bands. The BAND CHANGE control simultaneously operates the small MEGAHERTZ band indicating dial, located at the center of the panel and aligns the dial frequency indicator with the proper scale of the main dial.

CRYSTAL CONTROLLED HF OSCILLATOR - The XTALS control selects either variable high frequency oscillator operation or any one of the six crystal positions, for which similarly numbered crystal sockets are provided in the Crystal Control Unit. See Section III. The Δ FREQ control compensates for the small frequency tolerance to which the crystals are made.

METER SWITCH - The METER switch is a double pole, double throw toggle switch with spring return to the RF position. See Section II.

TUNING METER CONTROLS - The METER ADJ RF control is used to adjust the resistance shunting the meter when the METER switch is in the normal, or RF position. It is adjusted to produce a reading of plus 20 db on the RF scale of the meter, with a 10 microvolt RF input signal and with the AVC-MAN switch in the AVC position. Depression of the METER switch to the AF position converts the meter circuit for indication of the AF power output level in db from 6 milliwatts. This switch is spring return to the RF position when released and SHOULD NOT BE DEPRESSED FOR THE AF SCALE UNLESS THE AUDIO OUTPUT HAS BEEN ADJUSTED FOR LOW POWER OUTPUT, BY MEANS OF HEADPHONES OR SPEAKER. FAILURE TO OBSERVE THIS PRECAUTION MAY RESULT IN DAMAGE TO THE METER. The METER ADJ AF control is used to regulate the meter current when operating on the AF scale. This control is adjusted to obtain a 0 db reading on the AF scale of the meter and is made with the audio power output from the 600 ohm AUDIO OUTPUT terminals adjusted to 6 milliwatts, or 1.9 volts across a 600 ohm resistive load.

PRELIMINARY TO OPERATION - Turn the power switch "on" by turning the RF GAIN control clockwise and advance this control to 10. Note that the dial lamps light. Place the SEND-REC switch on REC and turn the BAND CHANGE control to the frequency band in which it is desired to operate. This should be done at least 15 minutes before using the receiver, in order to permit the tubes to warm up. Insert the headphones plug in the PHONES jack or use speaker as desired. See Section III.

MCW RECEPTION - Turn the TUNING LOCK to its extreme counter-clockwise position and turn the SELECTIVITY switch to 3 kHz. Put the USB-LSB-CW-MOD switch on MOD, the LIMITER switch to OFF, the AVC-MAN switch on AVC,

the XTAL PHASING control at its center position and turn the XTALS switch to VFO. With the BAND CHANGE control in the proper position for the frequency band desired, as indicated by the MEGAHERTZ dial, advance the AUDIO GAIN control until some noise is heard. Turn the TUNING control to indicate the desired frequency on the main dial and tune the signal for maximum response or indication on the RF Meter. At resonance the main dial reading should be within one-quarter of one percent of the signal frequency. Readjust the AUDIO GAIN control for the desired output level and as required to prevent overloading. Carefully tighten the TUNING LOCK by turning clockwise, if desired. The SELECTIVITY switch may be turned to the 8 kHz or 13 kHz position for improved high frequency response if the signal to noise ratio is sufficiently high. If the noise level is high, the SELECTIVITY switch should be turned to the bandwidth which provides the most intelligible reception and the LIMITER switch should be thrown "on." If the SELECTIVITY switch is used on any of the XTAL positions, the XTAL PHASING control may be adjusted to either side of its center position to attenuate an adjacent interfering signal. The RF GAIN control may be turned down somewhat to reduce noise, during stand-by periods in the transmission, when traversing the tuning range, or during deep fades of the signal. The RF Meter scale calibration is for maximum RF GAIN control operation and indicates only when the AVC-MAN switch is on AVC. When searching for very weak signals the USB-LSB-CW-MOD switch may be thrown to CW and the BEAT OSC control set at 0. Locate and tune the signal to obtain zero beat and then throw the USB-LSB-CW-MOD switch back to MOD.

The Crystal Frequency Control may be used for fixed frequency operation at any signal frequency for which crystals have been provided. See Section III . Turn the XTALS switch to the number corresponding to that on the panel chart for the desired signal frequency. Set the main tuning dial to the signal frequency and adjust the Δ FREQ control to obtain zero beat with the USB-LSB-CW-MOD switch on CW and the BEAT OSC control at 0. Throw the USB-LSB-CW-MOD switch to MOD and adjust the TUNING Control for maximum RF Meter indication or for maximum response.

CW RECEPTION - The preliminary procedure for CW reception is the same as for MCW reception above. Place the USB-LSB-CW-MOD switch on CW and with the BEAT OSC control at 0, tune the desired signal for zero beat. Adjust the BEAT OSC control, in either direction, to obtain the audio pitch desired. The AVC-MAN switch may be used in the position which gives the best reception. Adjust the desired output level by the AUDIO GAIN control when on AVC and by the RF GAIN control when on MAN. The RF Meter does not operate on the MAN position. The SELECTIVITY switch may be used in the XTAL positions, as found desirable, to reduce noise or to provide rejection of an interfering signal. The XTAL PHASING control is adjusted for minimum interference from an adjacent, interfering signal. If interference of this kind persists, further discrimination between the desired and the undesired signals may be realized by slightly detuning the desired signal to the opposite side of resonance from that on which the undesired signal is located and readjusting the XTAL PHASING control and the BEAT OSC control

for the desired signal. The Crystal Frequency Control may be used as described under MCW Reception above.

USB AND LSB RECEPTION - The SP-600-JX-21A is equipped to receive both upper sideband and lower sideband signals. Turn the USB-LSB-CW-MOD switch to USB to receive upper sideband signals, and turn the switch to LSB to receive lower sideband signals. Set the SELECTIVITY switch to 3 kHz. Set the RF GAIN to "10", and set AVC-MAN switch to AVC. Sideband signals sound rather nasal unless they are perfectly tuned in. Therefore, adjust the tuning knob carefully until the most intelligible signal is heard. Then set the audio gain to the desired level. Sideband signals can also be received with the USB-LSB-CW-MOD switch in the CW position. To receive upper sideband signals, turn the BFO to 1.5 kHz plus, and turn the BFO to 1.5 kHz minus for lower sideband reception. Then adjust the tuning knob for the most intelligible signal. In the CW position the BFO serves as a carrier oscillator. Therefore, a very slight adjustment in the BFO may be helpful in receiving a more pleasing signal.

If reception is to be suspended and resumed at short time intervals, the power should be left "on" and for such operation the SEND-REC switch should be thrown to SEND between reception periods. This keeps the receiver warm and ready for instant use.

When operation of the receiver is completed, turn the power "off" by extreme counter-clockwise rotation of the RF GAIN control.

V
MAINTENANCE

GENERAL - This receiver is designed for continuous duty and should normally require little attention beyond the replacement of tubes. An occasional cleaning of the gear teeth in the gear train is recommended to prevent a heavy accumulation of dust which may cause calibration error and improper operation of the gears. This may be done with a small stiff bristle brush, turning the controls to obtain access to the different portions of the gears. No grease or oil should be used on the gears. Operation and maintenance of the receiver will be greatly facilitated if the contents of this instruction book are thoroughly digested.

Some sectionalizing of faults is possible, if the fault is not existant on all of the frequency bands. Non-operation of the three lower frequency bands, with normal operation on the three higher frequency bands, indicates that the fault is associated with the circuits of tube V7. If only the three higher frequency bands are affected, the fault is associated with the circuits of V6 or V8. If only one single band is affected, refer to HF OSCILLATOR AND RF COIL ASSEMBLIES in this section.

Visual evidence of trouble is usually a burned or darkened resistor, which if found is likely caused by excessive current due to a short circuited

capacitor or tube element at the load side of the resistor. In such a case, both the capacitor or tube and the resistor should be replaced as indicated. Refer to Figures 8 to 12 and Table 5 for location and values of components. If the checks on tubes, fuses and visual inspection fail to disclose the fault, the tube socket voltages and resistances should be measured and checked against the values given in Tables 1 and 2. Any appreciable departure beyond a normal variation of approximately 15 percent from the values in these tables will generally indicate the component or circuit at fault. If the foregoing does not reveal the fault, then a stage by stage check of amplification should be made as shown in Table 4. Any great difference from the values of input shown in the table will indicate the stage at fault. If a tuned circuit component, such as an IF transformer, RF or HF oscillator coil assembly, is found defective and replaced only the replaced unit need be realigned. Follow the alignment procedure in Section VI, for the unit involved.

The IF Transformers, Crystal Filter, Beat Frequency Oscillator and the 3.5 mHz Crystal Controlled Oscillator assemblies are each mounted on the chassis independently of their respective shields. The shield can assemblies are easily removed for inspection of these units, without disturbing the soldered connections. In replacing these shields, make sure that the grounding springs are in place on the inductance adjuster screws before the shield is installed.

VACUUM TUBES - Weak or defective vacuum tubes are the most common cause of decrease in sensitivity, faulty performance or failure of operation in a receiver. In case of such faults, first remove the tubes and check them in a tube tester of reliable design. If a tube tester is not available, substitution of a new tube for each tube type and position should be tried. See Figures 1 and 2. Such substitution is best made, one tube at a time in order that the faulty tube may be detected by the improvement or restoration of performance by the new tube.

LOCATING FAULTS - If the dial lamps do not light when the power switch is turned on, check for a blown line fuse (F1), and replace it at the rear of the receiver from the spare fuses. An open circuit in the line cord or plug may be checked by plugging a lamp first in the power source receptacle and then in the ac receptacle on the rear of the receiver. If the dial lamps light but there is no sound at all in the headphones or speaker, check for a blown minus B fuse (F2), and if blown, replace it with a spare fuse. IN REPLACING FUSES, MAKE SURE THAT ONLY A 1.6 A MDL IS INSERTED IN THE LINE FUSE HOLDER AND THAT ONLY A 3/8 AMPERE FUSE IS INSERTED IN THE MINUS B FUSE HOLDER. Should neither fuse be blown, nor replacement of the fuses restore operation, the receiver should be removed from its cabinet or rack and inspected for visual signs of trouble. The table model receiver is held in the cabinet by two screws through the cabinet bottom and by the four screws through the slotted holes at each side of the front panel. The rack model receiver is provided with bottom and top cover plates which should be removed for purposes of inspection and repair.

IF TRANSFORMERS - If a fault is traced to one of the variable coupled IF Transformers, T4 or T5, check whether the fault exists on all positions of the selectivity switch S5, or only on one position of this switch. If the faulty operation occurs on only one switch position, check for continuity of the coupling coil associated with that position, check for imperfect soldered connections at the coil and switch terminals and check the switch contact involved. If faulty operation localized at one transformer exists on all positions of the selectivity switch, make the continuity check on the plate coils, on the main grid coil and on the wiring associated with these coils. Transformers T4 and T5 and Crystal Filter T3 have additional inner shield assemblies that are held in place by the tension nuts on the adjusting screws. To remove these shields, hold the adjusting screws with a screw driver to prevent turning the screws and losing the alignment adjustment and loosen the tension nuts, using another small screw driver engaging one of the slots. When replacing these shields and tension nuts, employ the same method and tighten the tension nuts just enough to prevent the adjusting screws from working loose.

BEAT FREQUENCY OSCILLATOR - To remove the beat frequency oscillator T6, if the receiver is equipped with the Crystal Frequency Control Unit T34, it will be necessary to set the crystal selector switch S2, on its number 3 position and loosen the four set screws in the rigid shaft coupling and the two set screws in the disc on the selector switch shaft. Slide the switch shaft forward through the coupling and disc. It may be necessary to remove burrs, caused by the set screws, from the switch shaft in order to slide the shaft through the disc. Now loosen the four set screws of the flexible coupling on the BFO shafts and slide the coupling forward on the BFO drive shaft in the front panel. Remove the BFO shaft bearing bracket by taking out the two screws holding it to the chassis. Unsolder the leads from the six terminals of the BFO unit at the underside of the chassis, BEING CAREFUL TO NOT OVERHEAT THE WIRE OF THE SHIELDED CABLE SINCE THIS WIRE IS INSULATED WITH POLYSTYRENE AND IS EASILY DAMAGED BY HEAT. Note that if this cable wire is grounded to its shield, there will be no beat frequency voltage input to the buffer tube V12 even though the beat oscillator is functioning properly. Therefore, with the shielded lead disconnected from the lug of the BFO unit, check with a continuity or ohmeter the connection of this wire to the buffer tube V12 and its freedom from the chassis. Carefully observe the wiring of the BFO unit for correct replacement. See T6 on Figure 13. Now remove the two screws holding the BFO shield can to the chassis and the two screws at the underside of the chassis and remove the BFO unit. When replacing the unit, follow the reverse procedure. Before tightening the two screws holding the unit to the chassis and the two screws holding the shaft bearing bracket, adjust the unit and shaft bracket to obtain alignment of the two shafts at the coupling. Make sure that the shield grounding spring is in place, with the bow of the spring downward against the tension nut, before replacing the shield can assembly.

ADJUSTMENT OF BFO - With the AVC-MAN switch on AVC, and the SELECTIVITY control on the .2 kHz position, tune in an unmodulated signal for maximum

tuning meter reading. Set the USB-LSB-CW-MOD switch to CW and with the BEAT OSC dial at 0, adjust the top screw of the BFO unit for zero beat. Turn the BEAT OSC dial to each 3 kHz position and check the output beat frequency against a known audio frequency source such as a good audio oscillator. If the beat frequencies obtained at each 3 kHz position is not within the range between 3 and 3.5 kHz, loosen the set screws of the BFO shaft coupling and turn the shaft of the BFO with respect to the drive shaft and repeat the above, resetting the 0 adjustment by the top screw of the BFO unit each time until the above range is realized. One set screw should be used just tightly enough to allow the drive shaft to operate the BFO shaft until the range is correct and then tighten both screws.

CRYSTAL SWITCH ADJUSTMENT - If the mechanical drive of the crystal control switch has been disturbed, it should be adjusted as follows: Carefully slide the switch shaft through the disc and into the rigid coupling and being careful not to turn the switch, tighten the four set screws in the rigid coupling, with the knob indicator on the number 3 position as originally set under BEAT FREQUENCY OSCILLATOR. Now set the crystal switch on the number 1 position and holding the disc in a counter-clockwise direction, so that the end of the slot in the disc is against the drive pin, lightly fasten the set screws of the disc. When this disc is properly adjusted on the shaft, with the switch in the number 1 position, the connecting bar between the two discs should not be under tension and should exhibit a slight amount of play when tried with the thumb and forefinger. When so adjusted, tighten the set screws.

CRYSTAL CONTROL UNIT - If it has been determined that the Crystal Control Unit is defective, it will be necessary to remove the unit for repair or replacement. Refer to Figures 11 and 12 and unsolder the lead of capacitor C60 from switch S3 on the gear plate. Unsolder the black, black-white, blue-red and red-white leads of the crystal control unit from terminal strip E13 underneath the chassis and unsolder the red lead of the unit from filter capacitor C161. Remove the XTALS switch shaft, as described under BEAT FREQUENCY OSCILLATOR. Loosen set screws and remove the Δ FREQ control knob. Remove the nut and lockwasher at the top of the bracket post adjacent to the power transformer and remove the bracket over the filter chokes. The front end of this bracket is slotted and engages a groove in a mounting post of the crystal control unit. Remove the four screws that secure the filter assembly panel to the mounting posts at each corner of this panel and move the filter assembly sufficiently to permit removal of the four screws holding the crystal control unit to the chassis. When these screws are removed, the unit may be taken from the receiver. In removing the unit and in subsequently handling it, be careful to avoid any strain on the Δ FREQ shaft, or the Δ FREQ capacitor may be damaged. Remove the four screws holding each of three sides of the cover and spring the two top ends of the cover enough to make the flanges clear the top of the box. Hold these flanges apart to prevent their edges from damaging the rf chokes in the unit while sliding the cover off the crystal unit box. When the unit is to be replaced follow the reverse of the above procedure. Follow the procedure under CRYSTAL SWITCH ADJUSTMENT to properly reinstall the switch mechanism.

HF OSCILLATOR AND RF COIL ASSEMBLIES - If faulty operation occurs in only one frequency band of the receiver, the trouble should be found in one of the four coil assemblies for that band in the tuning unit turret. For example: Coil assemblies T13, 19, 25 and 31 should be examined if band 7.4 to 14.8 mHz only, does not perform normally. To remove these coil assemblies stand the receiver on its right or left side and remove the bottom cover plate from the tuning unit. Turn the band change control to place the band in question in its normal operating position and then turn the band change control two and one-half revolutions counter-clockwise. This will place the band coil assemblies parallel and at the bottom of the tuning unit. Now remove the two springs holding one coil assembly in the turret and carefully remove it by sliding it towards you and off the tongues of the shields. It is best to remove only one coil assembly at a time and inspect it for defects or substitute a replacement assembly if available. CAUTION: MAKE SURE THAT THE COIL BASE IF FIRMLY SEATED AND SECURED BY ITS RETAINING SPRINGS BEFORE GOING TO THE NEXT ASSEMBLY OR TURNING THE BAND CHANGE CONTROL. FAILURE TO DO THIS MAY DAMAGE THE SWITCH SPRING CONTACTS BEYOND REPAIR. Repeat this procedure until the faulty assembly is found. In checking these assemblies, first check for continuity of the coils, particularly the small primary coils as in the RF Input assemblies, where they are liable to damage if the receiver is operated in the presence of very strong transmitter signals. In replacing these coil assemblies be careful that the end of the assembly nearest the coil is toward the front of the receiver.

MIXER PLATE COIL ASSEMBLY - Trouble in the Mixer Plate Coil Assembly T1, is indicated if the input required at pin 7 of V5 is found to be greatly different than the values shown in Table 4, and the gain from pin 7 of V6 is normal. To obtain access to the components of the mixer plate coil assemblies it is necessary to remove the crystal control unit and the filter assembly as described under CRYSTAL CONTROL UNIT. The cover plate and shield of T1 may then be removed for replacement of a defective component. If the entire assembly is to be replaced, it will be necessary to unsolder all of the leads at both the bottom and top terminal boards of the unit. Refer to Figure 11 for components and wiring of T1.

RF TUBE PLATFORM - If the receiver fails to perform normally on any of the six frequency bands and the previous tests indicate that performance of the IF and audio frequency amplifiers is normal, including the gain check in accordance with Table 4 for the input to pin 7 of V5, the fault is indicated to be in the RF Tube Platform or in the main tuning capacitor. Before removing the RF Tube Platform, it is advisable to remove the top shield cover and inspect the main tuning capacitor connections. Refer to Figures 7 and 11. Observe that the tuning capacitor is operating properly when the tuning control is rotated. Using a miniature tube adapter, see Section VI alignment, apply a modulated rf test signal successively to pin 1 of V1 and V2 and to pin 7 of V5. For each of these positions of the adapter and signal, tune through the proper dial setting for the signal frequency used. Gain of the order of 5 or 6 should be indicated for each stage and loss of signal will indicate the section to be investigated for the fault. No signal output, when the input signal is applied to pin 7 of V5, will indicate trouble in the HF oscillator section of the unit. With

the covers removed from the tuning capacitor and T1, refer to Figure 11 and unsolder the blue, white-black, red-white, red-green, yellow-black and blue-red leads that come from the tube platform at the top of T1. Unsolder the leads from the tuning capacitor rotors, stators and ground straps at each section. Unsolder the lead from the tube platform at S3. Turn the Band Change control one-half turn from any band position in order to have the band switch contacts disengaged and leave the band switch in this position until the RF tube platform is replaced, otherwise irreparable damage to the switch contacts will occur. Remove the four screws at the corners of the top of the platform and the four screws at the side flange and carefully remove the platform. In handling be careful to prevent damage to the switch contacts of this assembly. When the unit is ready to be replaced, follow the reverse of the above procedure.

MAIN TUNING CAPACITOR - If it is necessary to replace the main tuning capacitor, the procedure is as follows: Remove the top cover and unsolder the leads of the capacitor as described under RF TUBE PLATFORM. Bring the capacitor to full mesh by means of the tuning control. Carefully remove the spring and drive link at the front of the capacitor. Remove the single screw that secures the capacitor frame front plate to the gear plate, looping a piece of small wire around the spacing washer between the capacitor and gear plate. The front capacitor plate is located and held in position by two dowel pins and will not move when the front screw is taken out. Now hold the capacitor by its frame with one hand and remove the rear supporting screw and spacer. The capacitor may now be moved to the rear, to disengage the dowel pins, and lifted from the receiver. Follow the above procedure in reverse when replacing the capacitor.

PRODUCT DETECTOR ASSEMBLY - Failure to receive sideband signals, when MOD signals are received satisfactorily, indicates trouble in the product detector assembly. The product detector assembly is located under the power transformer. The product detector can be reached by removing the cover on the bottom of the cabinet. When only one sideband is received, check the carrier oscillator. If neither CW nor sidebands are received, check V200, the product detector tube.

TUBE SOCKET VOLTAGES—TABLE 1

Voltage to chassis. Measurements made with Weston Model 663 Volt-Ohmmeter, except those indicated by asterisk were made with Measurements Corp. Model 62 VTVM. The 500 volt scale was used for all voltages above 10 volts and the 10 volt scale for voltages below 10 volts. Line voltage 117, no signal input. Audio Gain control at minimum and USB-LSB-CW-MOD switch on "CW", AVC tap normal.

	SOCKET PIN NUMBERS									
TUBE	1	2	3	4	5	6	7	8	9	MODE OF OPERATION
V-1	*-1	-	*6.3ac	-	200	95	-	-	-	RF Gain max.
V-1	*-41	-	*6.3ac	-	260	245	-	-	-	RF Gain min.
V-2	*-1	-	*6.3ac	-	210	95	-	-	-	RF Gain max.
V-2	*-41	-	*6.3ac	-	260	245	-	-	-	RF Gain min.
V-3	-	-	-	-	-	0	*6.3ac	265	-	RF Gain max.-VFO operation
V-3	-	-	-	-	-	150	*6.3ac	265	-	RF Gain max.-Crystal Freq. Control
V-3	-	-	-	-	-	0	*6.3ac	290	-	RF Gain min.-VFO operation
V-3	-	-	-	-	-	150	*6.3ac	290	-	RF Gain min.-Crystal Freq. Control
V-4	130	-	*6.3ac	-	130	-	-	-	-	RF Gain max. or min.
V-5	-	1.2	*6.3ac	-	140	110	-	-	-	RF Gain max. or min.
V-6	-	-	*6.3ac	-	225	-	*-1	-	-	RF Gain max.-Freqs. below 7.4mc
V-6	-	-	*6.3ac	-	260	-	*-55	-	-	RF Gain min.-Freqs. below 7.4mc
V-6	-	-	*6.3ac	-	225	80	*-1	-	-	RF Gain max.-Freqs. above 7.4mc
V-6	-	-	*6.3ac	-	260	75	*-55	-	-	RF Gain min.-Freqs. above 7.4mc
V-7	*-1	-	*6.3ac	-	215	125	3.4	-	-	RF Gain max.-Freqs. below 7.4mc
V-7	*-54	-	*6.3ac	-	265	245	.4	-	-	RF Gain min.-Freqs. below 7.4mc
V-7	*-1	-	*6.3ac	-	215	0	0	-	-	RF Gain max.-Freqs. above 7.4mc
V-7	*-54	-	*6.3ac	-	265	0	0	-	-	RF Gain min.-Freqs. above 7.4mc
V-8	0	-	*6.3ac	-	0	-	-	-	-	Frequencies below 7.4mc
V-8	30	-	*6.3ac	-	30	-	-	-	-	Frequencies above 7.4mc
V-9	*-1	-	*6.3ac	-	205	90	-	-	-	RF Gain max.
V-9	*-54	-	*6.3ac	-	260	150	-	-	-	RF Gain min.
V-10	*-1	-	*6.3ac	-	205	90	-	-	-	RF Gain max.
V-10	*-54	-	*6.3ac	-	260	150	-	-	-	RF Gain min,
V-11	*-7.8	-	*6.3ac	-	210	140	-	-	-	RF Gain max.
V-11	*-7.8	-	*6.3ac	-	235	140	-	-	-	RF Gain min.
V-12	-	-	*6.3ac	-	210	40	-	-	-	RF Gain max.-BFO Injection max.
V-12	-	-	*6.3ac	-	240	45	-	-	-	RF Gain min.-BFO Injection max.
V-13	25	-	*6.3ac	-	25	-	-	-	-	RF Gain max. or min.
V-14	-	-	*6.3ac	-	*22	-	-	-	-	RF Gain max. or min.
V-15	-	-	*6.3ac	-	-	-	-	-	-	RF Gain max. or min.
V-16	50	-	1.5	-	-	210	-	6.4	*6.3ac	RF Gain max.
V-16	57	-	1.6	-	-	240	-	7.4	*6.3ac	RF Gain min.
V-17	-	-	260	228	-	-	*6.3ac	12	-	RF Gain max.
V-17	-	-	280	265	-	-	*6.3ac	13	-	RF Gain min.
V-18	150	-	-	-	150	-	-	-	-	RF Gain max. or min.
V-19	-	300	-	-	-	-	-	300	-	RF Gain max.-*5 V ac Pin 2 to Pin 8
V-19	-	320	-	-	-	-	-	320	-	RF Gain min.-*5 V ac Pin 2 to Pin 8
V-20	-	*-96	*6.3ac	-	-	-	*-96	-	-	RF Gain max.
V-20	-	*-97	*6.3ac	-	-	-	*-97	-	-	RF Gain min.
V-200	150	0	0.25	6.3 ac	6.3ac	150	0	0.25	0	RF Gain max.
V-201	180	0	8.0	6.3 ac	6.3ac	85	-15	8.0	0	RF Gain max.

TUBE SOCKET TERMINAL RESISTANCE—TABLE 2

Resistance to chassis. Measurements made with Weston Model 663 Volt-Ohmmeter.

Tube removed from socket under measurement. Audio Gain Control at maximum, RF Gain Control at minimum. Limiter Switch "OFF", USB-LSB-CW-MOD Switch on "CW", AVC-MAN Switch on "AVC", AVC tap normal.

SOCKET PIN NO.	1	2	3	4	5	6	7	8	9	MODE OF OPERATION
TUBE SOCKET										
V-1	1.8M	0	-	0	16.7K	50K	0	-	-	
V-2	1.8M	0	-	0	16.7K	50K	0	-	-	
V-3	0	-	0	47K	0	17.5K	-	15.6K	-	Crystal Freq. control ps. 1-6
V-4	Inf.	Inf.	-	0	Inf.	47K	0	-	-	Crystal Freq. control ps. 1-6
V-4	I9K	Inf.	-	0	Inf.	47K	0	-	-	VFO Operation
V-5	47K	150	-	0	19K	22K	26K	-	-	Freq. Band 1.35-3.45mc
V-6	22K	0	-	0	17.4K	Inf.	1.1M	-	-	Freq. Bands below 7.4mc
V-6	22K	0	-	0	17.4K	37.4K	1.1M	-	-	Freq. Bands above 7.4mc
V-7	980K	0	-	0	17.4K	Inf.	390	-	-	Freq. Bands above 7.4mc
V-7	980K	0	-	0	17.4K	48K	390	-	-	Freq. Bands below 7.4mc
V-8	-	-	-	0	Inf.	22K	0	-	-	Freq. Bands below 7.4mc
V-8	-	-	-	0	117K	22K	0	-	-	Freq. Bands above 7.4mc
V-9	1.1M	0	-	0	17.5K	9.5K	0	-	-	
V-10	1.1M	0	-	0	17.5K	9.5K	0	-	-	
V-11	93K	0	-	0	17.5K	19K	0	-	-	
V-12	1.5	0	-	0	17.5K	115K	*	-	-	*0 to 1K (BFO Injection control)
V-13	-	-	-	0	162K	100K	0	-	-	
V-14	0	816K	-	0	15.6K	0	196K	-	-	
V-15	69K	Inf.	-	0	Inf.	0	196K	-	-	
V-16	125K	500K	1K	0	0	17.4K	470K	680	-	
V-17	0	0	15.6K	15.2K	470K	Inf.	-	360	-	
V-18	118K	-	-	-	20K	-	0	-	-	
V-19	-	15.8K	0	42	-	40	-	15.8K	-	
V-20	49K	65K	-	0	49K	0	65K	-	-	
V-200	18K	100K	1K	0	0	70K	100K	1K	0	
V-201	18K	1meg.	Inf.	0	0	18K	1meg.	Inf.	0	

VI
ALIGNMENT

The alignment of a modern communications Receiver requires precision instruments and a thorough knowledge of the circuits involved. Because this receiver is a double super-heterodyne, the alignment procedure is even more involved than is usual.

Under normal service the receiver will stay in alignment for extremely long periods of time, consequently realignment should not be attempted unless all other possible causes of a particular trouble have been eliminated. When it has been determined that any realignment should be attempted, a great deal of caution should be exercised in making the adjustments, as any required readjustment should not entail more than a slight angular motion of the adjusting screw.

ALIGNMENT OF THE IF STAGES

The low frequency IF should be aligned first. The recommended method for aligning the low frequency IF involves the use of a sweep frequency signal generator and an oscilloscope. Since these instruments are not available at the average service station the alternate method using an amplitude modulated signal generator and an output meter will be described first. The additional information required for the visual alignment method will be covered in a later paragraph.

The signal generator should be coupled to the grid of the mixer tube V5 through a capacitance of approximately .01 mfd. A miniature tube adapter will be required to make the mixer grid connection available. A suitable adapter, A/N No. CV-49519, is available as Part No. 977 from Alden Manufacturing Co., 117 N. Main Street, Brockton, Mass. An output meter should be connected across the output terminals of the receiver or the speaker voice coil. The receiver controls should now be set as follows:

CONTROL		POSITION
Selectivity	-	See text
Send-Receive	-	Receive
USB-LSB-CW-MOD	-	Mod
Phasing	-	Arrow
AVC-Man	-	Man
Audio Gain	-	Set for approx. 20 volts
RF Gain	-	See text
Band Switch	-	1.35-3.45 mHz
Dial	-	2.5 mHz

The signal generator should be modulated 30 percent at 400 hertz. Turn the selectivity switch to the 2 kHz position and advance the RF Gain control to maximum. Set the signal generator frequency to 455 kHz and adjust its output until some deflection is noted on the output meter. Refer to figure 3 for the location of the various alignment adjustments. Adjust L42, L41, L39, L38, L36 and L32 for maximum output, reducing the signal generator output and the RF Gain control as required to prevent overload or excessive output. Now turn the selectivity switch to the narrowest position, .2 kHz and adjust the signal generator frequency for the maximum output. This establishes the correct signal frequency by the 455 kHz crystal for the IF amplifier and the frequency of the signal generator should not be disturbed for the remainder of the low frequency IF alignment, unless it should be to recheck this establishment of crystal frequency to make sure that the signal generator frequency has not drifted during the alignment. The selectivity switch is now turned to the 3 kHz position and L42, L41, L39, L38, L36 and L32 are again adjusted for maximum output. Now turn the selectivity switch to the 1.3 kHz position and adjust L37 for maximum output. Before changing this set-up the BFO should be turned on by rotating the USB-LSB-CW-MOD switch to CW and checked for zero beat with the BFO knob dial at its zero reading. If necessary L44 should be adjusted for zero output. This check and adjustment of the BFO should be done with the signal generator carrier unmodulated.

The procedure for the visual method of aligning the low frequency IF should be the same as the above except that the adjustments are made for both maximum amplitude and coincidence of the oscilloscope images. The oscilloscope vertical input should be connected across the diode detector load resistance, from the junction of R64 and R65 to chassis.

The high frequency IF should be aligned next. Set the band switch to the 7.4-14.8 mHz band. The selectivity switch should be in the 3 kHz position. Adjust the signal generator frequency to 3.955 mHz and adjust L31, L33 and L34 for maximum output.

The 3.5 mHz crystal used in the second conversion oscillator circuit is held to a very close frequency tolerance and may be used as a frequency standard at multiples of 3.5 mHz from 10.5 mHz upwards. In order to do this, in view of the complete shielding against radiation from this oscillator, it will be necessary to temporarily connect a two foot length of insulated wire to the antenna terminal and dress the free end of this lead around the tube shield on the 3.5 mHz oscillator tube V8. This test lead should, of course, be removed except while in use as a frequency standard.

ALIGNMENT OF THE RF AMPLIFIER & HF OSCILLATOR

To adequately align the RF Amplifier and HF Oscillator an accurately calibrated signal generator and an output meter are required. The frequencies required are shown in Table 3. The location of the adjustments is shown in Figure 2. The use of Table 3 and Figure 2 should be made in following this part of the alignment which will now be described for one frequency band. The same procedure should then be followed for the other frequency bands.

To align the .54 - 1.35 MHz band the signal generator is coupled to the antenna input terminal through a 100 ohm carbon resistor. The generator should be modulated 30% at 400 cycles and the output meter connected across the receiver output terminals. The receiver controls should be set as follows:

CONTROL	POSITION
Selectivity	3 kHz
Send-Receive	Receive
USB-LSB-CW-MOD	MOD
AVC-Man	See Text
Audio Gain	Set for approx. 20 volts
RF Gain	See Text
Band Switch	Set for band to be aligned
Limiter	Off

Set the receiver and signal generator dials to .56 MHz. The RF Gain control should be set at maximum and the AVC-Man switch set on AVC. The HF Osc. L adjustment shown in Figure 2, should now be set for maximum output. Then the Ant., 1st. RF and 2nd. RF L adjustments should be set for maximum output. The receiver and signal generator dials are now set to 1.3 MHz and the C adjustments, shown in Figure 2, should be adjusted for maximum output in the same order, beginning with the Osc. C adjustment and then making the C adjustments for the Ant., 1st. RF and 2nd. RF. This procedure should be carefully repeated until no increase in output can be realized. The AVC-Man switch should then be set to Man and the signal generator should be set for approximately 3 micro-volts. The L and C adjustments should now be checked for maximum output, adjusting the RF Gain control as found necessary to maintain the output at approximately 20 volts.

Following the frequencies, shown in Table 3, align the remaining bands using the same procedure as above.

TABLE No. 3

RF AND HF OSCILLATOR ALIGNMENT FREQUENCIES AND ADJUSTMENT DESIGNATIONS

FREQ. BAND IN MHz	.54 - 1.35	1.35 - 3.45	3.45 - 7.4	7.4 - 14.8	14.8 - 29.7	29.7 - 54.0
RF & HF OSC. ADJUST L AT.	.56	1.4	3.75	7.5	15.0	30.0
RF & HF OSC. ADJUST C AT.	1.3	3.4	7.15	14.5	29.0	52.0

TABLE No. 4

APPROXIMATE SIGNAL INPUT AT IF & AF STAGES FOR 20 VOLTS OUTPUT

Output measured across a 600 ohm resistive load at output terminals of receiver. RF signals modulated 30% at 400 Hz. Signals applied to tube grids through a .01 mfd capacitor. Selectivity switch at 3 kHz AVC-MAN switch on MAN. CW-MOD switch on MOD, RF Gain and Audio Gain at max.

BAND SWITCH	FREQUENCY	INPUT TO	APPROX. INPUT
Any	Audio 400 Hertz	Pin 5, V17	5.5 volts
Any	Audio 400 Hertz	Pin 2, V16B	.5 volts
1.35 - 3.45 MHz	Mod RF 455 kHz	Pin 1, V11	.6 volts
1.35 - 3.45 MHz	Mod RF 455 kHz	Pin 1, V10	15000 microvolts
1.35 - 3.45 MHz	Mod RF 455 kHz	Pin 1, V9	300 microvolts
1.35 - 3.45 MHz	Mod RF 455 kHz	Pin 1, V7	75 microvolts
1.35 - 3.45 MHz	Mod RF 455 kHz	Pin 7, V5	90 microvolts
7.40 - 14.8 MHz	Mod RF 3.955 MHz	Pin 7, V5	70 microvolts
7.40 - 14.8 MHz	Mod RF 3.955 MHz	Pin 7, V6	100 microvolts

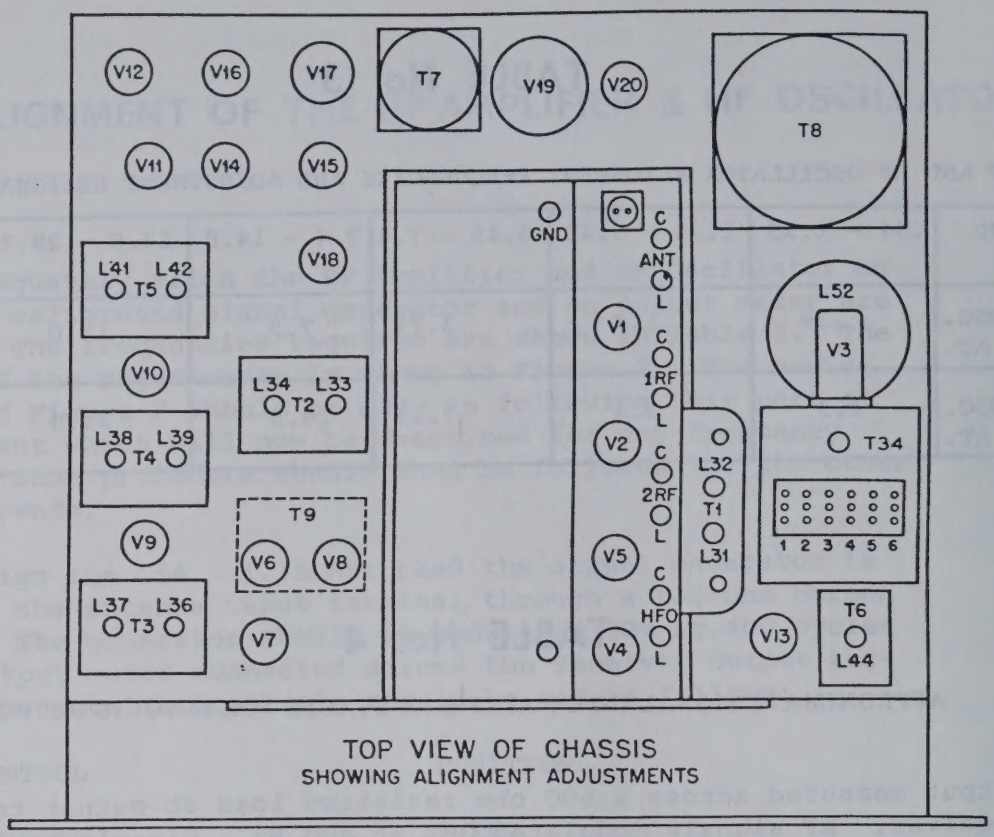


FIG. 2

• AUDIO AND OVERALL FIDELITY CURVES •

———— CURVE - Audio frequency amplifier. Input to Pin 2,V16B.

– – – – – CURVE - Overall fidelity at 2.5 MHz. Modulation 30%. Selectivity switch in 13 kHz position. RF Gain set for 20 volts output at 400 Hz.

Output measured across a 600 ohm resistive load. Audio gain control at maximum for both curves.

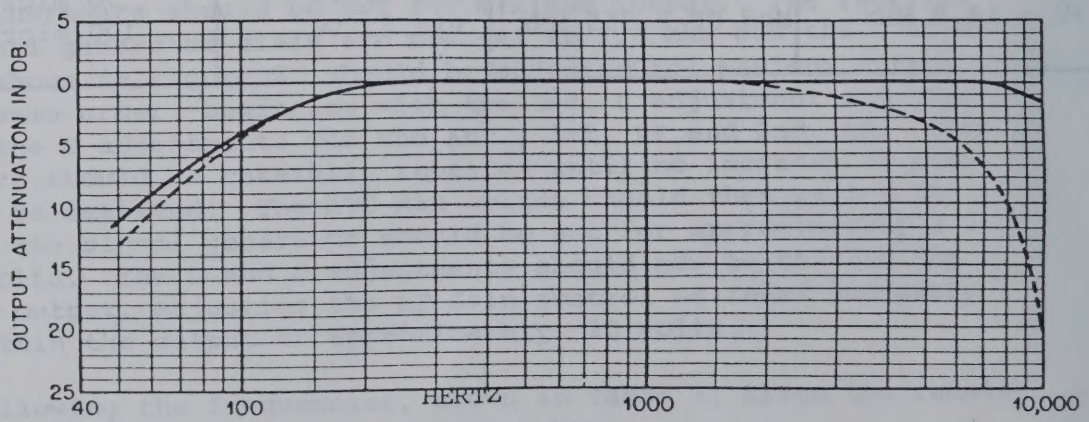


FIG. 3

SELECTIVITY CURVES

OVERALL AT 2 MEGAHERTZ

NUMBERS DENOTE SELECTIVITY SWITCH POSITIONS
1, 2 and 3 NON CRYSTAL - 4, 5 and 6 CRYSTAL

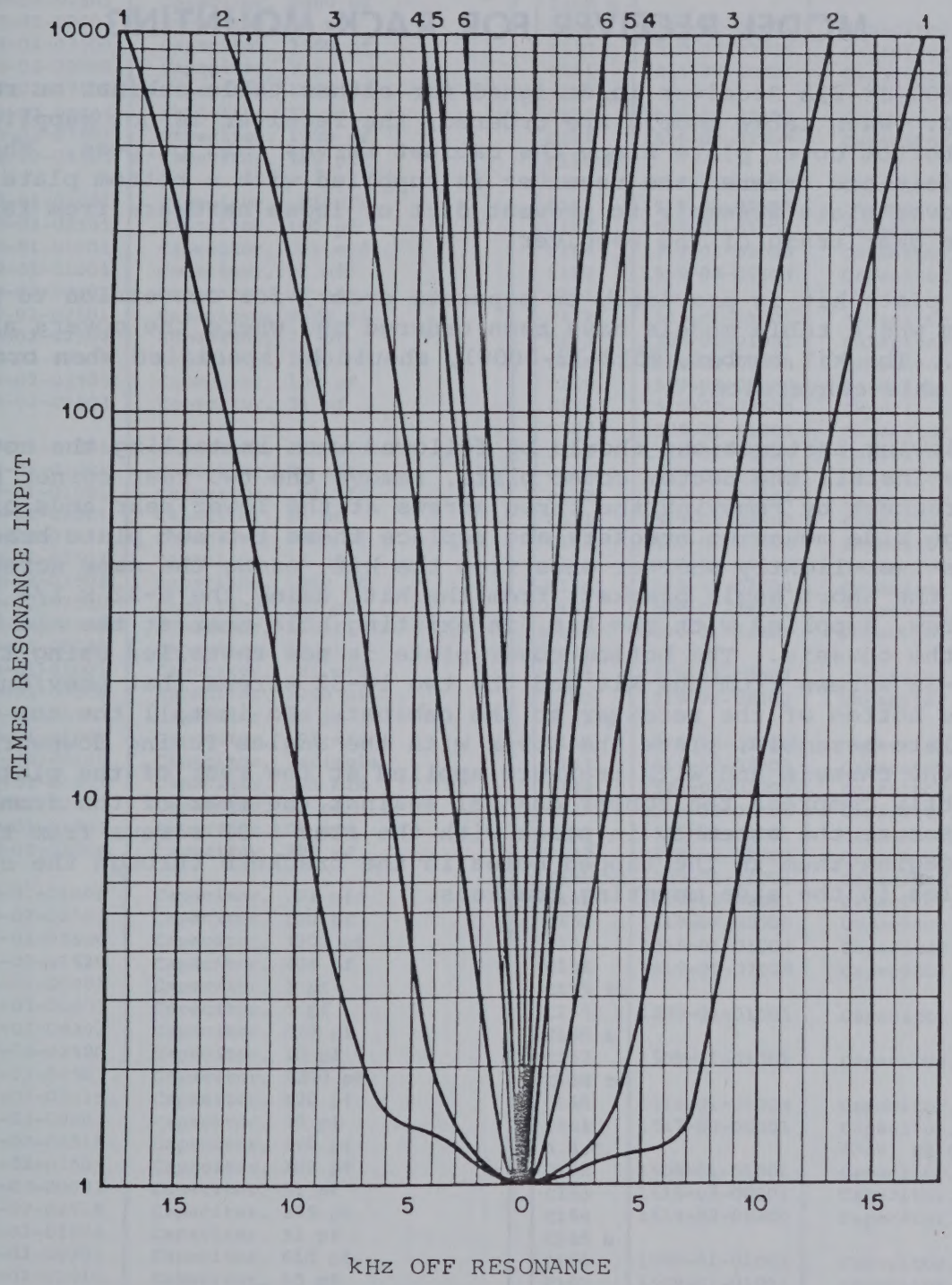


FIG. 4

VII
CONVERSION OF TABLE MODEL RECEIVER FOR RACK MOUNTING

The SP-600-JX-21A Receiver is designed for either table cabinet or rack mounting. When table models are ordered, the receiver is not supplied with a bottom cover plate since the cabinet serves this purpose. When rack models are ordered the receiver is supplied with a bottom plate and a top cover plate assembly to prevent dirt or loose hardware from falling into the gear train of the receiver.

A cover plate kit is provided, on separate order, for conversion to rack mounting where table models have been ordered and where the covers are desired. The kit number, 9012-12-00001, should be specified when ordering for this conversion.

The following instructions should be followed when installing the cover kit: To install the bottom cover plate, remove the two rear corner nut plate brackets by removing the three screws at the lower rear ends of the large side mounting brackets and replace these two nut plate brackets with the two slightly shorter ones from the kit, using the same screws. Install the short angle bracket, from the kit, using the 6-32 x 1/4 long sems screw, supplied with the kit, in existing hole nearest the mid bottom of the chassis. The bottom cover plate is now installed using the five 10-32 screws from the kit and the two 10-32 screws that previously held the bottom of the receiver to the cabinet. To install the top cover plate assembly, place the cover with the angles facing downward toward the chassis and with pressure applied at the rear of the plate, to slightly compress the rubber channel against the rear of the front panel, secure the assembly in place with the four 6-32 screws from the kit, engaging them in the tapped holes in the brackets through the clearance holes in the side mounting brackets.

TABLE No. 5
PARTS LIST

ITEM	HAMMARLUND PART NO.	DESCRIPTION
C1A - to H	9434-00-10003	Capacitor, variable, 8 sec.
C3	1509-01-01001	Capacitor, .01 mfd
C5	1509-01-01001	Capacitor, .01 mfd
C6	1519-02-02501	Capacitor, 20 pf
C8	1519-02-07501	Capacitor, 2400 pf
C9	1519-02-02502	Capacitor, 33 pf
C11	1519-02-07505	Capacitor, 1500 pf
C12	1509-02-02006	Capacitor, 7 pf
C14	1519-02-07502	Capacitor, 1000 pf
C15	1509-02-02005	Capacitor, 15 pf
C17	1519-02-07505	Capacitor, 1500 pf
C18	1519-02-02505	Capacitor, 100 pf
C19 to C24	1509-01-01001	Capacitor, .01 mfd
C25	1519-02-02505	Capacitor, 100 pf
C27	1509-01-01001	Capacitor, .01 mfd
C29	1509-01-01001	Capacitor, .01 mfd
C30	1519-02-02501	Capacitor, 20 pf
C32	1519-02-07501	Capacitor, 2400 pf
C33	1519-02-02502	Capacitor, 33 pf
C35	1519-02-07505	Capacitor, 1500 pf
C37	1519-02-02505	Capacitor, 100 pf
C39	1519-02-02504	Capacitor, 51 pf
C40 to C44	1509-01-01001	Capacitor, .01 mfd
C47	1509-01-01001	Capacitor, .01 mfd
C49	1509-01-01001	Capacitor, .01 mfd
C50	1519-02-02501	Capacitor, 20 pf
C52	1519-02-07501	Capacitor, 2400 pf
C53	1519-02-02502	Capacitor, 33 pf
C55	1519-02-07505	Capacitor, 1500 pf
C57	1519-02-02505	Capacitor, 100 pf
C59	1519-02-02504	Capacitor, 51 pf
C60	1519-03-00003	Capacitor, 12 pf
C61	1509-01-01001	Capacitor, .01 mfd
C62	1519-02-07500	Capacitor, 2200 pf
C63	1519-02-02503	Capacitor, 39 pf
C64	1509-01-01001	Capacitor, .01 mfd
C65	9411-72-60109	Capacitor, variable
C66	1509-01-01001	Capacitor, .01 mfd
C67	1519-02-02517	Capacitor, 85 pf
C68	1509-01-01001	Capacitor, .01 mfd
C69	1519-02-02506	Capacitor, 220 pf
C70 to C74	1509-01-01001	Capacitor, .01 mfd
C75	1519-02-02505	Capacitor, 100 pf
C77	1519-02-07506	Capacitor, 3300 pf
C78	1519-02-02520	Capacitor, 404 pf
C79	1519-03-00001	Capacitor, 5 pf
C80	1519-03-00001	Capacitor, 5 pf
C82	1519-02-08202	Capacitor, 810 pf
C83	1519-02-02500	Capacitor, 10 pf
C85	1519-02-07503	Capacitor, 1200 pf
C87	1519-02-02515	Capacitor, 120 pf
C88	1519-03-00003	Capacitor, 12 pf
C89	1519-02-02519	Capacitor, 190 pf
C91	1519-02-02505	Capacitor, 100 pf
C92	1519-03-00002	Capacitor, 51 pf
C93	1519-02-02518	Capacitor, 379 pf
C95	1519-02-02504	Capacitor, 51 pf
C96	1519-02-08201	Capacitor, 610 pf
C97	1519-02-02516	Capacitor, 65 pf
C98	1509-01-01001	Capacitor, .01 mfd
C99	1519-02-02504	Capacitor, 51 pf

ITEM	HAMMARLUND PART NO.	DESCRIPTION
C102 to 104	1509-01-01001	Capacitor, .01 mfd
C105	1509-01-01001	Capacitor, .01 mfd
C106	1509-01-01001	Capacitor, .01 mfd
C107	1519-02-02506	Capacitor, 220 pf
C108 & C109	1509-01-01001	Capacitor, .01 mfd
C110	1519-02-02505	Capacitor, 100 pf
C111	9411-77-60001	Capacitor, variable
C112 & C113	1519-02-02505	Capacitor, 100 pf
C114	1519-02-02507	Capacitor, 270 pf
C115 & C116	1509-01-01001	Capacitor, .01 mfd
C117	1519-02-02506	Capacitor, 220 pf
C118	1509-01-01001	Capacitor, .01 mfd
C119	1519-02-02508	Capacitor, 300 pf
C120	1519-02-07504	Capacitor, 1300 pf
C121 & C122	1509-01-01001	Capacitor, .01 mfd
C123	1509-01-01001	Capacitor, .01 mfd
C124	1519-02-02506	Capacitor, 220 pf
C125	1519-02-02508	Capacitor, 300 pf
C126	1519-02-07504	Capacitor, 1300 pf
C127	1509-01-01001	Capacitor, .01 mfd
C128	1515-01-01004	Capacitor, 10 mfd, 100V
C129	1523-02-03000	Capacitor, .05 mfd
C130	1519-03-00004	Capacitor, 27 pf
C131	1519-02-08200	Capacitor, 430 pf
C132	1519-02-07501	Capacitor, 2400 pf
C133	1519-02-08200	Capacitor, 430 pf
C134	1519-02-02504	Capacitor, 51 pf
C135	1509-01-01001	Capacitor, .01 mfd
C136	1509-01-01001	Capacitor, .01 mfd
C138 & C139	1519-03-00002	Capacitor, 51 pf
C140	1519-02-08200	Capacitor, 430 pf
C141 & C142	1519-03-00200	Capacitor, 100 pf
C143	1519-02-02003	Capacitor, 5100 pf
C144	1523-02-03001	Capacitor, .05 mfd
C145	1509-02-02005	Capacitor, 15 pf
C146	1509-01-01001	Capacitor, .01 mfd
C147	1519-02-02003	Capacitor, 5100 pf
C148	1509-01-01001	Capacitor, .01 mfd
C149	1519-02-02003	Capacitor, 5100 pf
C150	1519-02-08000	Capacitor, 2500 pf, 800V
C151	1515-01-01004	Capacitor, 10 mfd, 100V
C152	1519-01-07508	Capacitor, .01 mfd, 500V
C153 to C155	1509-01-01001	Capacitor, .01 mfd
C156 & C157	1509-01-01001	Capacitor, .01 mfd
C158 to C160	1515-01-01004	Capacitor, 10 mfd, 100V
C161 A,B,C,	1517-03-00001	Capacitor, 3 x 20 mfd, 450V, HS Can, Elect.
C162	1509-01-01001	Capacitor, .01 mfd
C163	1515-03-00001	Capacitor, .25 mfd, 600V
C164	1519-02-08200	Capacitor, 430 pf
C165 & C166	1509-01-01001	Capacitor, .01 mfd
C167	1509-01-01001	Capacitor, .01 mfd
C168 & C169	1519-01-07508	Capacitor, .01 mfd, 500V

PARTS LIST (Continued)

ITEM	HAMMARLUND PART NO.	DESCRIPTION
C187	1523-02-03000	Capacitor, .05 mfd
C200	1519-02-00063	Capacitor, 39 pf
C201	1523-02-03003	Capacitor, .22 mfd
C202	1513-01-00025	Capacitor, 7 - 25 pf
C203	1519-01-00047	Capacitor, 5 pf
C204	1528-01-03003	Capacitor, .01 mfd, 250V
C205	1519-01-00094	Capacitor, 680 pf
C206	1519-01-00007	Capacitor, 220 pf
C207	1528-01-03003	Capacitor, .01 mfd, 250V
C208	1528-01-03003	Capacitor, .01 mfd, 250V
C209	1519-01-00007	Capacitor, 220 pf
C210	1519-01-00094	Capacitor, 68 pf
C211	1519-01-00007	Capacitor, 220 pf
C212	1519-01-00007	Capacitor, 220 pf
C213	1519-01-00043	Capacitor, 100 pf
C214	1528-01-03002	Capacitor, .047 mfd, 250V
C215	1515-02-01013	Capacitor, 12 mfd, 250V
C216	1513-01-00025	Capacitor, 7 - 25 pf
C217	1519-01-00047	Capacitor, 5 pf
E2	2887-04-00001	4 Screw Terminal, Audio Output
E3	2887-04-00002	4 Screw Terminal, Diode and AVC
E4-5	2885-03-00004	1 Solder Terminal strip (left)
E6	2885-03-00002	1 Solder Terminal strip (right)
E7	2885-04-00003	2 Solder Terminal strip
E8	2885-03-00004	1 Solder Terminal strip (left)
E9 to E12	2885-03-00002	1 Solder Terminal strip (right)
E13	9012-03-00107	10 Solder Terminal Board
E14	2885-03-00001	6 Solder Terminal Strip
E15 & E16	2885-03-02002	8 Solder Terminal Strip
E17	2885-03-02001	15 Solder Terminal Strip
E18	9012-03-00011	3 Solder Terminal Strip (meter)
F1	5134-01-00250	Fuse, 1.6 amp - MDL
F2	5134-01-00208	Fuse, 3/8 amp
I1 to I4	3901-01-00001	Dial Lamp, No. 47 Mazda
J1	2106-01-00003	Antenna input socket, UG-103/U
J2	2111-01-00001	IF Output Socket, SO-239
J3	2109-04-00001	Phone Jack, JK-34-A
J5	2102-01-00001	Power receptacle
L7	1803-03-00001	RF Choke, 192 uh
L14	1803-03-00001	RF Choke, 192 uh
L21	1802-03-00001	RF Choke, 1 mh
L22	1804-03-00003	RF Choke, 10 mh
L23	1804-03-00004	RF Choke, 25 mh
L24	1802-01-00001	RF Choke, 2.5 mh
L35	1803-03-00001	RF Choke, 192 uh
L46	1810-03-00004	RF Choke, 12 mh
L47	1805-03-00003	RF Choke, 3.0 mh
L48	1804-04-00001	RF Choke, 2 ∼ dc
L49 & L50	1804-04-00002	RF Choke, 2.7 ∼ dc

ITEM	HAMMARLUND PART NO.	DESCRIPTION
L51	5627-04-00001	1st Filter Choke, 8.5 Hy, 170 ∼ dc
L52	5626-04-00001	2nd Filter Choke, 20 Hy, 440 ∼ dc
L53	1803-03-00002	IF Output transformer
L200	1802-01-00015	Choke, 2.5 mh
L201	1802-01-00015	Choke, 2.5 mh
L202	1801-02-00050	Choke, 10 mh
M1	2902-02-00017	Tuning Meter
P1	6070-04-00001	Power plug and cord
P2	2112-01-00004	Antenna Input Plug, UG-102/U
P3	2112-01-00003	Antenna Adapter Connector, UG-104/U
P4	2112-01-00001	Cable Connector Plug, PL-259 (for J2)
R1	4728-02-00001	Resistor, 510K∼, 1/3 Watt
R2	4703-02-00471	Resistor, 10K∼, 1/2 Watt
R3	4703-02-00483	Resistor, 33K∼, 1/2 Watt
R4	4703-01-00332	Resistor, 1000∼, 1/2 Watt
R5	4703-02-00440	Resistor, 510∼, 1/2 Watt
R6	4703-01-00332	Resistor, 1000∼, 1/2 Watt
R7 & R8	4703-02-00416	Resistor, 51∼, 1/2 Watt
R9	4703-02-00408	Resistor, 24∼, 1/2 Watt
R10 & R11	4703-01-00312	Resistor, 22∼, 1/2 Watt
R12	4703-02-00471	Resistor, 10K∼, 1/2 Watt
R13	4728-02-00001	Resistor, 510K∼, 1/3 Watt
R14	4703-02-00483	Resistor, 33K∼, 1/2 Watt
R15	4703-02-00440	Resistor, 510∼, 1/2 Watt
R16	4703-01-00332	Resistor, 1000∼, 1/2 Watt
R17 & R18	4703-02-00416	Resistor, 51∼, 1/2 Watt
R19	4703-02-00408	Resistor, 24∼, 1/2 Watt
R20 & R21	4703-01-00312	Resistor, 22∼, 1/2 Watt
R22 & R23	4703-01-00352	Resistor, 47K∼, 1/2 Watt
R24 & R25	4703-01-00323	Resistor, 180∼, 1/2 Watt
R26	4728-02-00001	Resistor, 510K∼, 1/3 Watt
R27	4703-02-00427	Resistor, 150∼, 1/2 Watt
R28	4703-01-00342	Resistor, 6800∼, 1/2 Watt
R29 & R30	4703-01-00332	Resistor, 1000∼, 1/2 Watt
R31	4703-01-00336	Resistor, 2200∼, 1/2 Watt
R32	4703-02-00440	Resistor, 510∼, 1/2 Watt
R33	4703-01-00334	Resistor, 1500∼, 1/2 Watt
R35	4703-01-00356	Resistor, 100K∼, 1/2 Watt
R36	4703-02-00479	Resistor, 22K∼, 1/2 Watt
R37	4703-01-00336	Resistor, 2200∼, 1/2 Watt
R38	4703-01-00356	Resistor, 100K∼, 1/2 Watt
R39	4703-02-00483	Resistor, 33K∼, 1/2 Watt
R40	4703-02-00460	Resistor, 20K∼, 1 Watt
R41	4703-01-00336	Resistor, 2200∼, 1/2 Watt
R42	4703-01-00308	Resistor, 10∼, 1/2 Watt
R43	4703-01-00356	Resistor, 100K∼, 1/2 Watt
R44	4703-02-00471	Resistor, 10K∼, 1/2 Watt
R45	4703-02-00432	Resistor, 240∼, 1/2 Watt
R46	4703-02-00448	Resistor, 1100∼, 1/2 Watt
R47	4703-02-00347	Resistor, 18K∼, 1/2 Watt

PARTS LIST (Continued)

ITEM	HAMMARLUND PART NO.	DESCRIPTION
R48	4703-01-00368	Resistor, 1 megΩ, 1/2 Watt
R49	4703-01-00336	Resistor, 2200Ω, 1/2 Watt
R50	4703-01-00308	Resistor, 10Ω 1/2 Watt
R51	4703-01-00356	Resistor, 100KΩ, 1/2 Watt
R52	4703-02-00471	Resistor, 10KΩ, 1/2 Watt
R53	4703-02-00471	Resistor, 10KΩ, 1/2 Watt
R54	4703-01-00336	Resistor, 2200Ω, 1/2 Watt
R55	4703-01-00308	Resistor, 10Ω, 1/2 Watt
R56	4703-01-00356	Resistor, 100KΩ, 1/2 Watt
R57	4703-02-00471	Resistor, 10KΩ, 1/2 Watt
R58	4703-01-00336	Resistor, 2200Ω, 1/2 Watt
R59	4704-01-00636	Resistor, 2200Ω, 1 Watt
R60 & R61	4703-01-00368	Resistor, 1 megΩ, 1/2 Watt
R62	4703-01-00356	Resistor, 100KΩ, 1/2 Watt
R63	4703-01-00349	Resistor, 27KΩ, 1/2 Watt
R64	4703-01-00352	Resistor, 47KΩ, 1/2 Watt
R65	4703-02-00479	Resistor, 22KΩ, 1/2 Watt
R66	4703-02-00347	Resistor, 18KΩ, 1/2 Watt
R67 & R68	4703-01-00356	Resistor, 100KΩ, 1/2 Watt
R69	4735-03-00002	Resistor, Variable, 3300Ω
R70	4703-02-00471	Resistor, 10KΩ, 1/2 Watt
R72	4714-02-03000	Resistor, 7500Ω, 20 Watt
R73	4714-02-03001	Resistor, 10KΩ, 20 Watt
R74	4735-03-00001	Resistor, variable, 1000Ω
R75 & R76	4703-01-00356	Resistor, 100KΩ, 1/2 Watt
R77	4703-01-00352	Resistor, 47KΩ, 1/2 Watt
R78	4703-01-00364	Resistor, 470KΩ, 1/2 Watt
R79	4703-01-00330	Resistor, 680Ω, 1/2 Watt
R80	4703-01-00336	Resistor, 2200Ω, 1/2 Watt
R81	4703-01-00356	Resistor, 100KΩ, 1/2 Watt
R82	4703-02-00471	Resistor, 10KΩ, 1/2 Watt
R83	4703-01-00332	Resistor, 1000Ω, 1/2 Watt
R84	4735-01-01450	Resistor, variable, 500KΩ
R85	4714-02-02500	Resistor, 2500Ω, 10 Watt
R86	4703-02-00493	Resistor, 82KΩ, 1/2 Watt
R87 & R88	4703-02-00408	Resistor, 120KΩ, 1/2 Watt
R89	4703-02-00493	Resistor, 82KΩ, 1/2 Watt
R90 to R92	4703-02-00471	Resistor, 10KΩ, 1/2 Watt
R93	4735-02-08400	Resistor, variable, 50KΩ includes switch S10
R94	4703-02-00448	Resistor, 1100Ω, 1/2 Watt
R95	4703-02-00493	Resistor, 82KΩ, 1/2 Watt
R96	4703-01-00479	Resistor, 22KΩ, 1/2 Watt
R97	4703-01-00374	Resistor, 3.3 megΩ, 1/2 Watt
R98	4703-01-00364	Resistor, 470KΩ, 1/2 Watt
R99	4704-02-00736	Resistor, 360Ω, 1 Watt
R100	4703-01-00356	Resistor, 100KΩ, 1/2 Watt
R101 R103 to	4735-02-01401	Resistor, variable, 25KΩ
R110	4703-01-00349	Resistor, 27KΩ, 1/2 Watt
R111	4703-01-00356	Resistor, 100KΩ, 1/2 Watt
R112	4703-02-00437	Resistor, 390Ω, 1/2 Watt
R113	4703-02-00507	Resistor, 330KΩ, 1/2 Watt
R114	4703-01-00332	Resistor, 1000Ω, 1/2 Watt
R115 & R116	4703-01-00370	Resistor, 1.5 megΩ, 1/2 Watt
R200	4703-01-00373	Resistor, 2.7 megΩ, 1/2 Watt
R201	4703-01-00356	Resistor, 100KΩ, 1/2 Watt
R202	4703-01-00368	Resistor, 1 megΩ, 1/2 Watt
R203	4703-01-00332	Resistor, 1KΩ, 1/2 Watt
R204	4703-01-00356	Resistor, 100KΩ, 1/2 Watt
R205	4703-01-00332	Resistor, 1KΩ, 1/2 Watt
R206	4703-01-00368	Resistor, 1 megΩ, 1/2 Watt
R207	4703-01-00352	Resistor, 47KΩ, 1/2 Watt
R208	4703-01-00334	Resistor, 1.5KΩ, 1/2 Watt
S1A, B,C,D	9012-03-00052	Switch base and spring assembly
S2	5106-03-00002	Crystal selector switch
S3	5106-03-00001	Crystal switch
S4	5101-02-00005	Conversion Switch
S5A, B, C	5108-03-00002	Selectivity Switch
S6	5101-02-00004	Toggle Switch SPST
S8	5102-02-00001	Toggle Switch DPDT
S9	5101-02-00004	Toggle Switch SPST
S10		Switch "ON-OFF" part of R93
S11	5102-02-00006	Switch, DPDT, spring return
S200	5106-02-00038	Switch 4 position
T1	9012-03-00059	Mixer plate coil assembly, includes C67,69,70,L31,32, & R31
T2	9012-03-00088	IF Transformer assembly, includes C97,98,99,L33,34 & R35
T3	9012-03-00087	Crystal Filter assembly, includes C107,110,111,112, 113,114,L36,37,R41, & Y8
T4	9012-03-00084	IF Transformer assembly, includes C117,118,119,120, L38,39,40 & R49
T5	9012-03-00084	IF Transformer assembly, includes C123,124,125,126, L41,42,43 & R54
T6	9012-03-00115	Beat Frequency Osc. assem., includes C130,131,132,133, 134, L44,45,46, R76 & 77
T7	5618-04-00001	Transformer, Audio Output
T8	5606-04-00001	Transformer, Power
T9	9012-03-00089	3.5 mc Osc. assembly, includes C103,104,L35, R38,40 & Y7
T10	9012-03-00066	RF Input assembly, includes C2,3, L1 and switch contacts for S1A
T11	9012-03-00069	RF Input Assembly, includes C4,5, L2 and switch contacts for S1A
T12	9012-03-00072	RF Input assembly, includes C6,7,8, L3 and switch contacts for S1A
T13	9012-03-00075	RF Input assembly, includes C9,10,11, L4 and switch contacts for S1A
T14	9012-03-00078	RF Input assembly, includes C12,13,14, L5 and switch contacts for S1A
T15	9012-03-00081	RF Input assembly, includes C15,16,17, L6 and switch contacts for S1A
T16	9012-03-00065	RF Transformer assembly, includes C26,27, L8, R7, 103 and switch contacts for S1B

PARTS LIST (Continued)

ITEM	HAMMARLUND PART NO.	DESCRIPTION
T17	9012-03-00068	RF Transformer assembly, includes C28,29,L9,R8,105 and contacts,switch, for S1B
T18	9012-03-00011	RF Transformer assembly, includes C30,31,32, L10, R9 107 and switch contacts for S1B
T19	9012-03-00074	RF Transformer assembly, includes C33,34,35, L11, R10 109 and switch contacts for S1B
T20	9012-03-00077	RF Transformer assembly, includes C36,37, L12 and switch contacts for S1B
T21	9012-03-00080	RF Transformer assembly, includes C38,39, L13 and switch contacts for S1B
T22	9012-03-00065	RF Transformer assembly, includes C46,47, L15, R17 104 and switch contacts for S1C
T23	9012-03-00068	RF Transformer assembly, includes C48,49, L16, R18, 106 and switch contacts for S1C
T24	9012-03-00011	RF Transformer assembly, includes C50,51,52, L17, R19, 108 and switch contacts for S1C
T25	9012-03-00074	RF Transformer assembly, includes C53,54,55, L18, R20, 110 and switch contacts for S1C
T26	9012-03-00077	RF Transformer assembly, includes C56,57, L19 and switch contacts for S1C
T27	9012-03-00080	RF Transformer assembly, includes C58,59, L20 and switch contacts for S1C
T28	9012-03-00064	HF Osc. assembly, includes C76,77,78, L25 and switch contacts for S1D
T29	9012-03-00067	HF Osc. assembly, includes C81,82, L26 and switch contacts for S1D
T30	9012-03-00070	HF Osc. assembly, includes C83,84,85, L27 and switch contacts for S1D
T31	9012-03-00073	HF Osc. assembly, includes C86,87,88,89, L28 and switch contacts for S1D
T32	9012-03-00076	HF Osc. assembly, includes C90,91,92,93, L29 and switch contacts for S1D
T33	9012-03-00079	HF Osc. assembly, includes C94,95,96, L30 and switch contacts for S1D
T34	9012-03-00002	Crystal control assembly, includes C60,61,62,63,64,65, 67, 8,11,12, L21,22,23, R23, 24,25, X3, 21 to 26
X1-2	2125-03-00020	Tube socket, miniature
X3	2126-01-00001	Tube socket, octal
X4	2125-04-00021	Tube socket, miniature ceramic, less center shield
X5	2125-02-00050	Tube socket, miniature ceramic, with center shield
X6 to X15	2125-03-00020	Tube socket, miniature
X16	2125-02-00100	Tube socket, noval
X17	2126-01-00001	Tube socket, octal
X18	2125-03-00020	Tube socket, miniature
X19	2126-01-00001	Tube socket, octal
X20	2125-03-00020	Tube socket, miniature
X21 to X26	2311-01-00001	Crystal socket, ceramic, for crystals Y1 to Y6
Y1 to Y6	2305-02-00087	Crystal, CR-18/U, SEE NOTE
Y7	2304-02-00013	Crystal, 3.5mc
Y8	2303-02-00002	Crystal, 455 kc
MISC.	2418-02-00024	Chart, frequency control
	9012-03-00036	Dial, band indicator
	3926-03-00001	Dial, Lamp Socket assem.
	2402-02-00002	Dial, main tuning
	2402-02-00003	Dial, vernier tuning
	5136-01-00001	Fuse Holder
	2430-01-00101	Knob
	2430-02-00102	Knob
	2430-02-00126	Knob
	2430-02-00125	Knob
	2430-05-00102	Knob
	2870-51-00004	Knurled thumb screw
	9012-03-00005	Shaft Coupling, rigid
	9400-41-50003	Shaft Coupling, flexible soft
	9400-41-50002	Shaft Coupling, flexible stiff
	2531-01-00004	Snap Button Plug
	1439-02-00010	Spare Fuse Cover
	2537-01-00026	Spring, anti-backlash
	2537-01-00024	Spring, Band Change Detent
	2537-02-00022	Spring, Conversion Switch
	2537-02-00017	Spring, Crystal Retaining
	2537-01-00018	Spring, IF Adjuster grounding
	2537-01-00020	Spring, Indicator Slide
	2537-01-00023	Spring, Retainer for RF Coils
	2537-01-00021	Spring, Retainer for RF Coil assemblies
	2411-01-00009	Window, Band Indicator
	2411-01-00010	Window, Tuning Dials

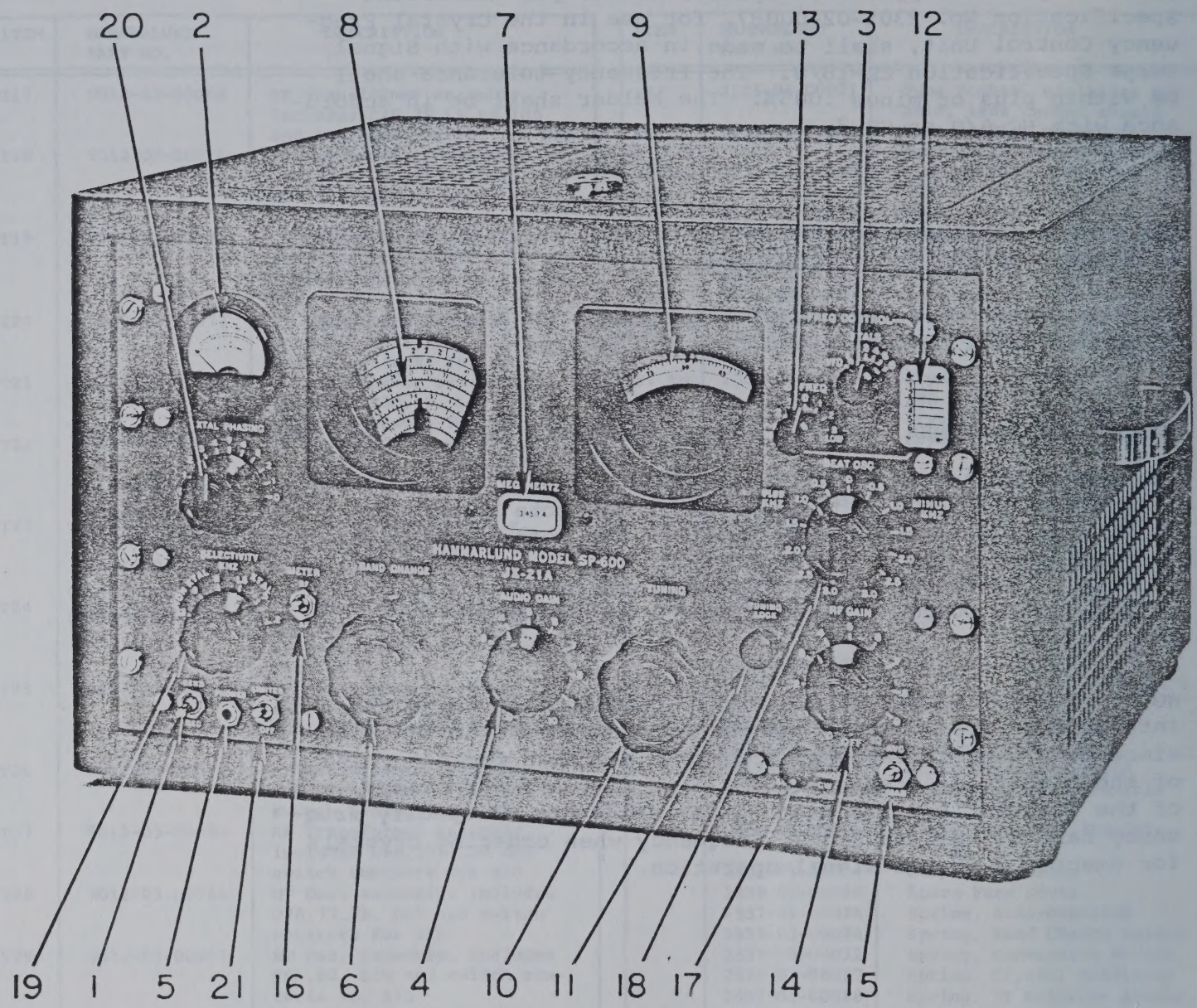
NOTE: Crystals supplied on special order, per Hammarlund Specification No. 2305-02-00087, for use in the Crystal Frequency Control Unit, shall be made in accordance with Signal Corps Specification CR-18/U. The frequency tolerance shall be within plus or minus .005%. The holder shall be in accordance with HC-6/U or CR-7.

The SIGNAL FREQUENCY for which the crystal is to be used shall be stamped on the top of the holder.

The oscillator or actual crystal frequency for a given signal frequency shall be determined from the following:

SIGNAL FREQUENCY MHz	ADD IF FREQUENCY MHz	MODE OF OPERATION
00.75000 to 07.39999	0.455000	Fundamental
07.40000 on 3.45 to 7.40 band	0.455000 (see note below)	Fundamental
07.40000 on 7.40 to 14.8 band	3.955000 (see note below)	Fundamental
07.40001 to 12.04499	3.955000	Fundamental
12.0450 to 44.04499	3.955000 and divide sum by 3	3rd Harmonic
44.0450 to 54.00000	3.955000 and divide sum by 4	4th Harmonic

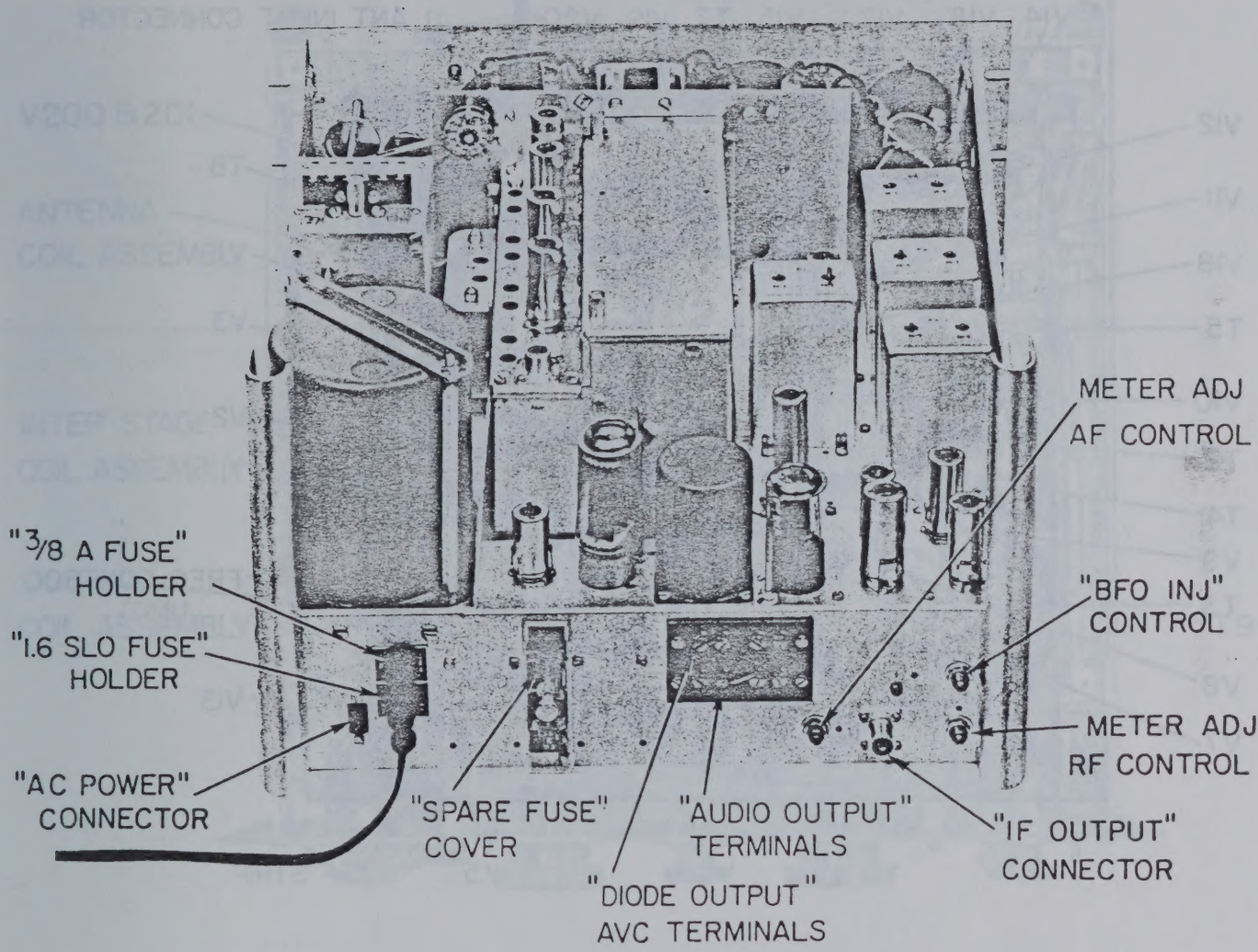
NOTE: Since 7.40 MHz is the signal frequency at which the intermediate frequency is changed for double conversion and since this signal frequency occurs at the high frequency end of the 3.45 to 7.40 MHz band and also at the low frequency end of the 7.40 to 14.8 MHz band, it is necessary to specify frequency band as well as Signal Frequency when ordering crystals for exactly 7.40 MHz signal operation.



FRONT VIEW OF RECEIVER

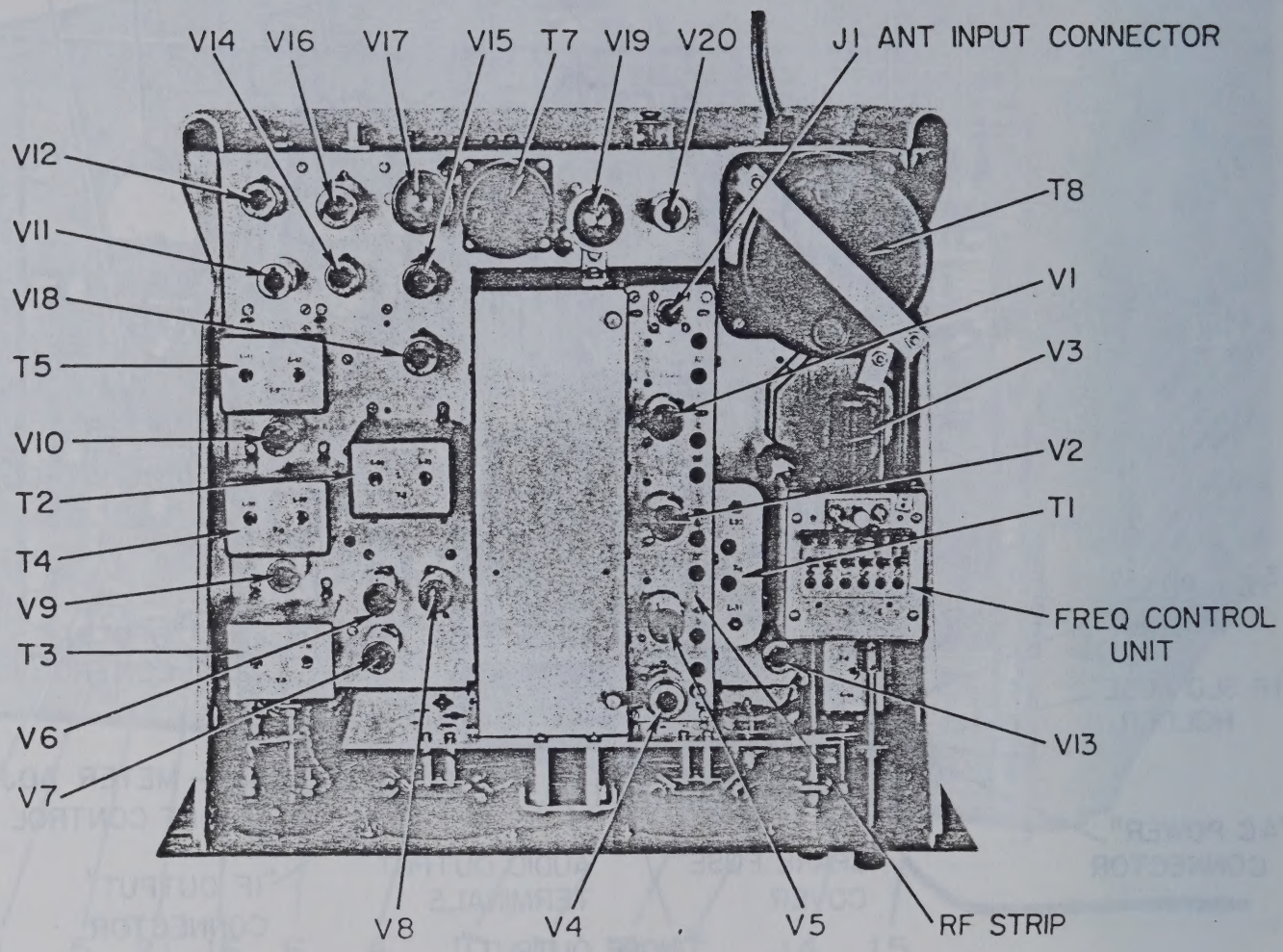
FIG. 5

1. "SEND" "REC" Switch
2. Tuning Meter
3. "FREQ CONTROL" "XTALS" Switch
4. "AUDIO GAIN" Control
5. "PHONES" Jack
6. "BAND CHANGE" Control
7. "MEGAHERTZ" Window
8. Main Tuning Dial
9. Vernier Dial
10. "TUNING" Control
11. "TUNING LOCK"
12. Frequency Chart
13. "FREQ CONTROL"
    " Δ FREQ" Control
14. "RF GAIN" Control
15. "AVC" "MAN" Switch
16. "METER" "RF" "AF" Switch
17. "USB-LSB-CW-MOD" Switch
18. "BEAT OSC" Control
19. "SELECTIVITY" Switch
20. "XTAL PHASING" Control
21. "LIMITER" "OFF" Switch



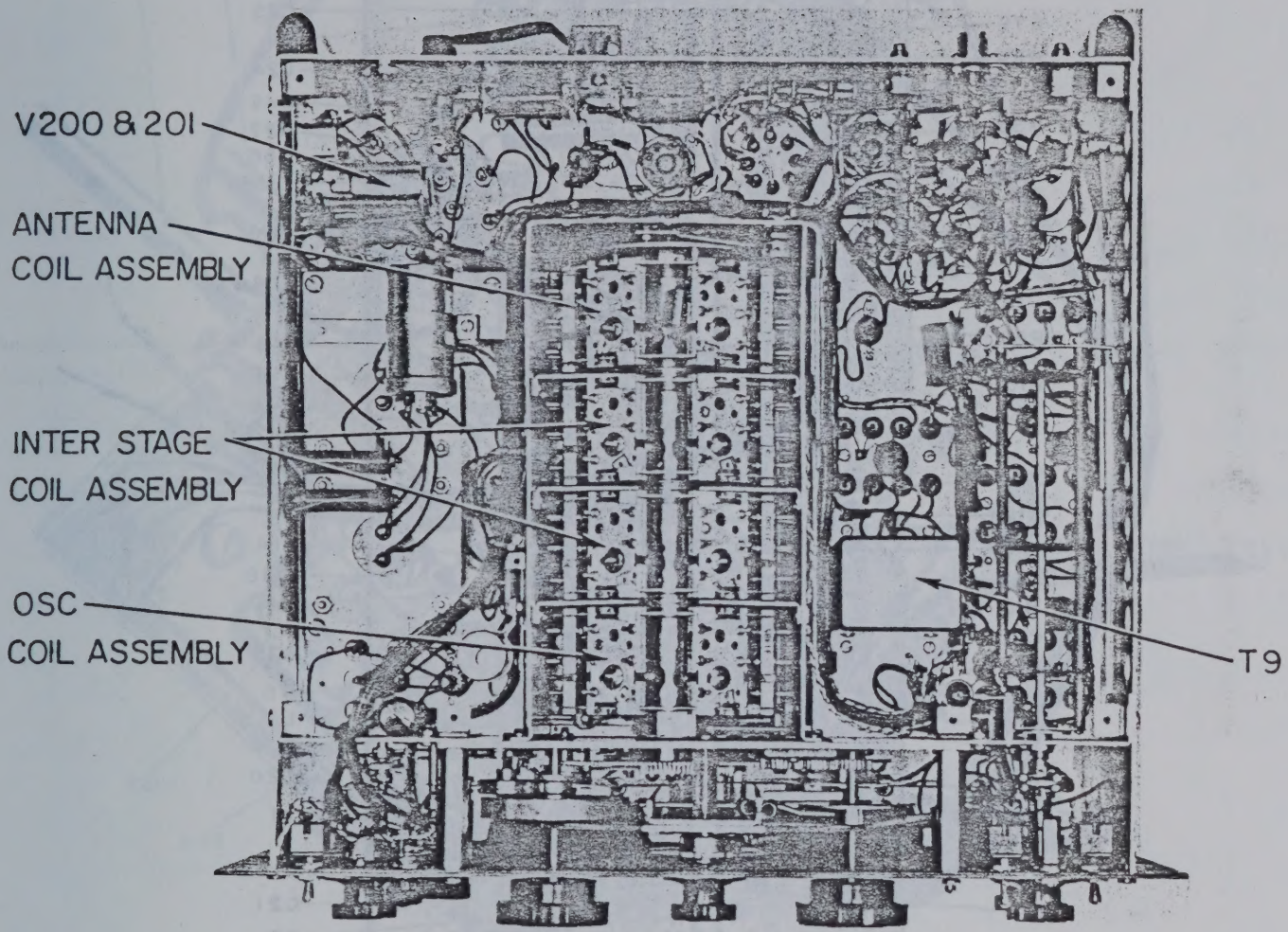
REAR VIEW OF RECEIVER

FIG. 6



TOP VIEW OF RECEIVER

FIG. 7



BOTTOM VIEW OF RECEIVER

FIG. 8

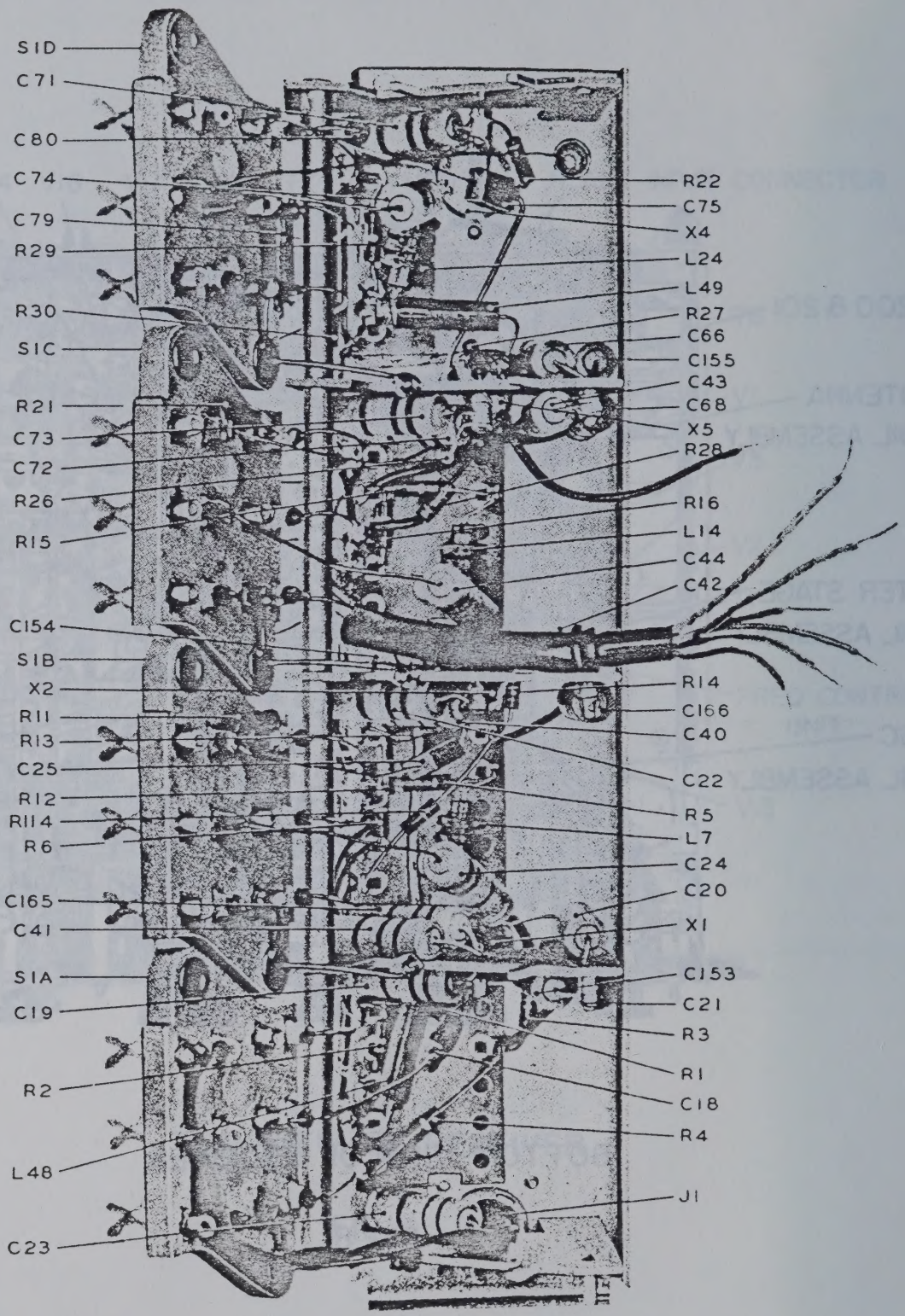


FIG. 9

BOTTOM VIEW OF RF TUBE PLATFORM

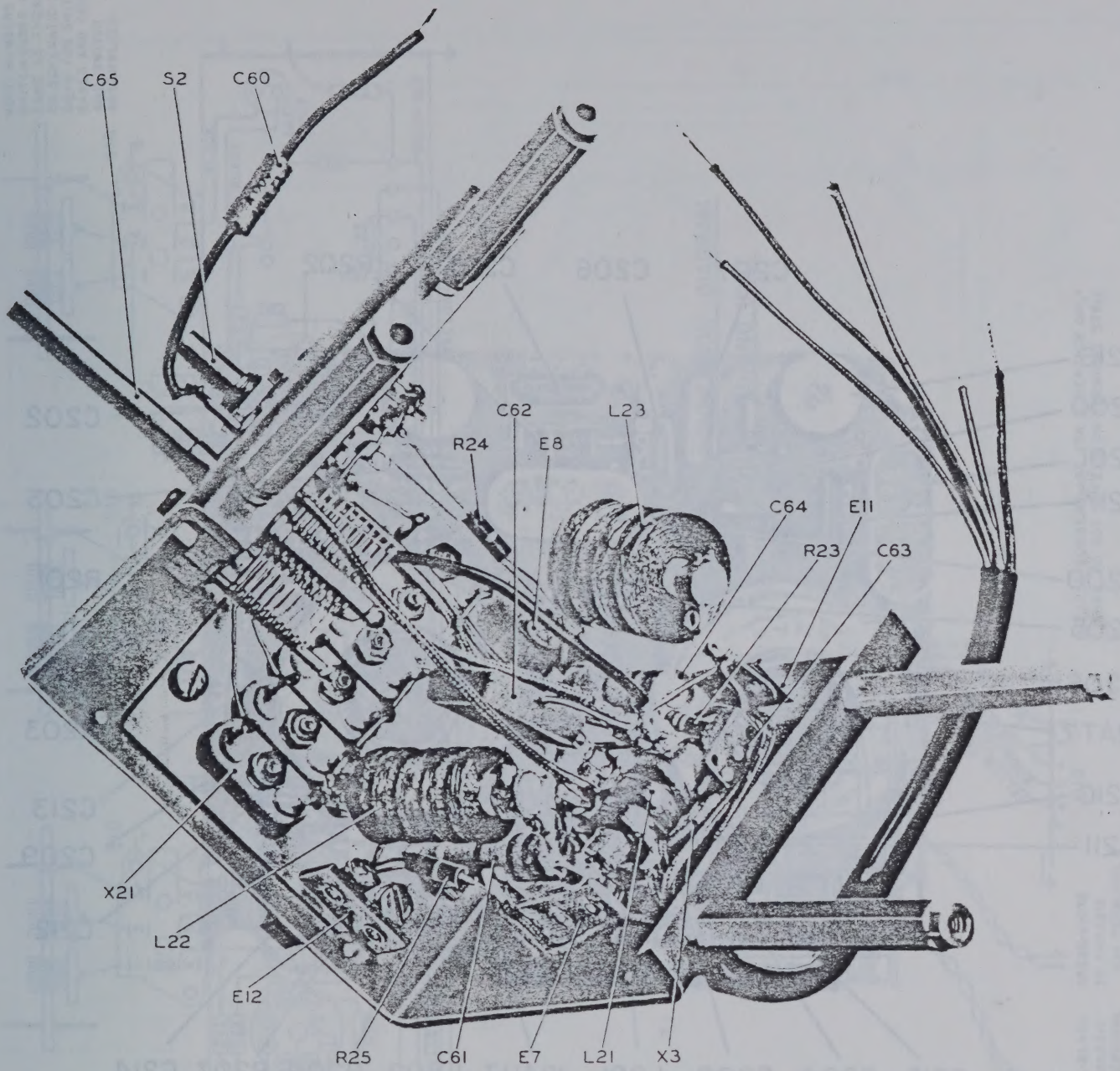
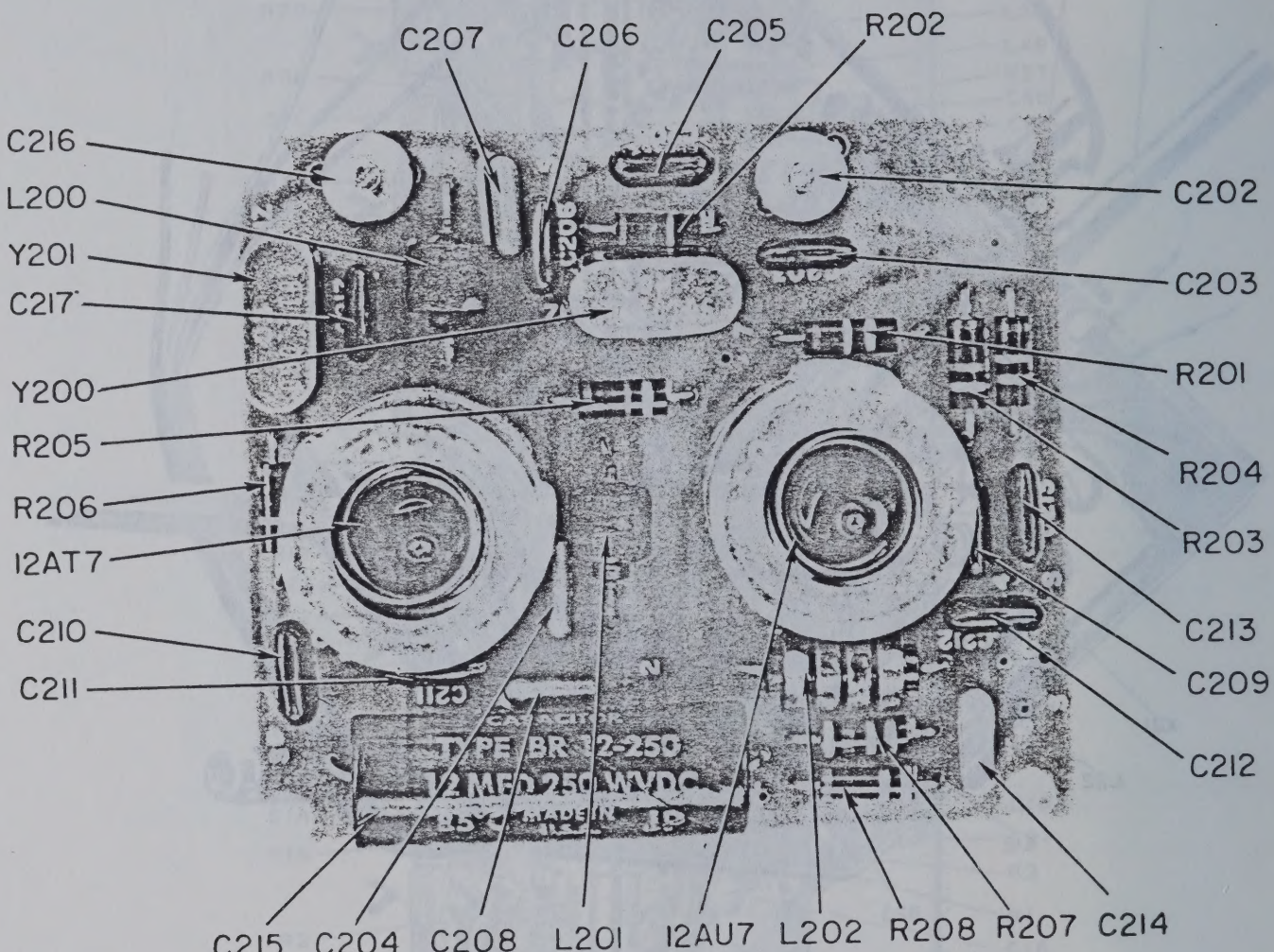


FIG. 10

BOTTOM VIEW OF FREQUENCY CONTROL UNIT



PRODUCT DETECTOR ASSEMBLY

FIG. 11

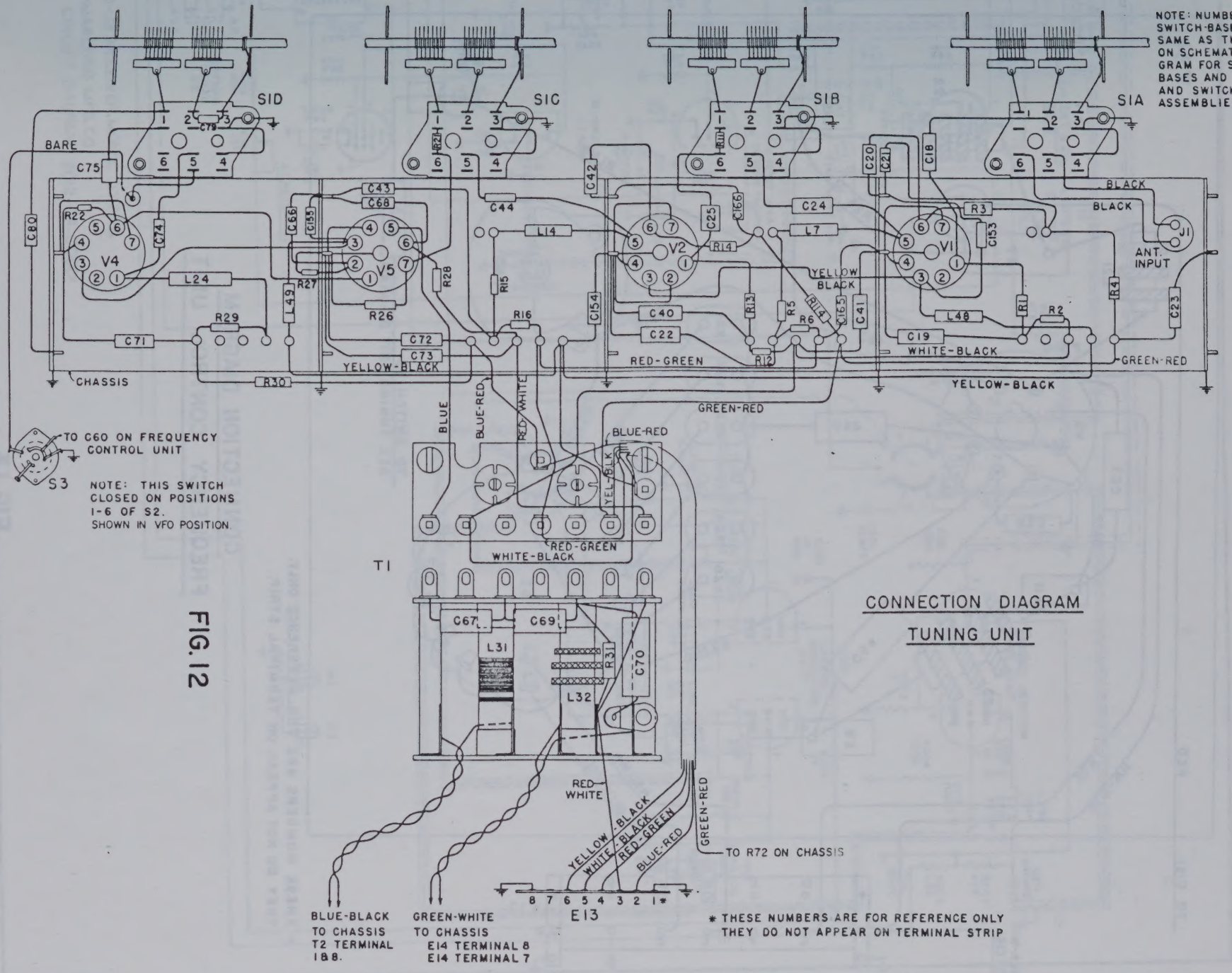
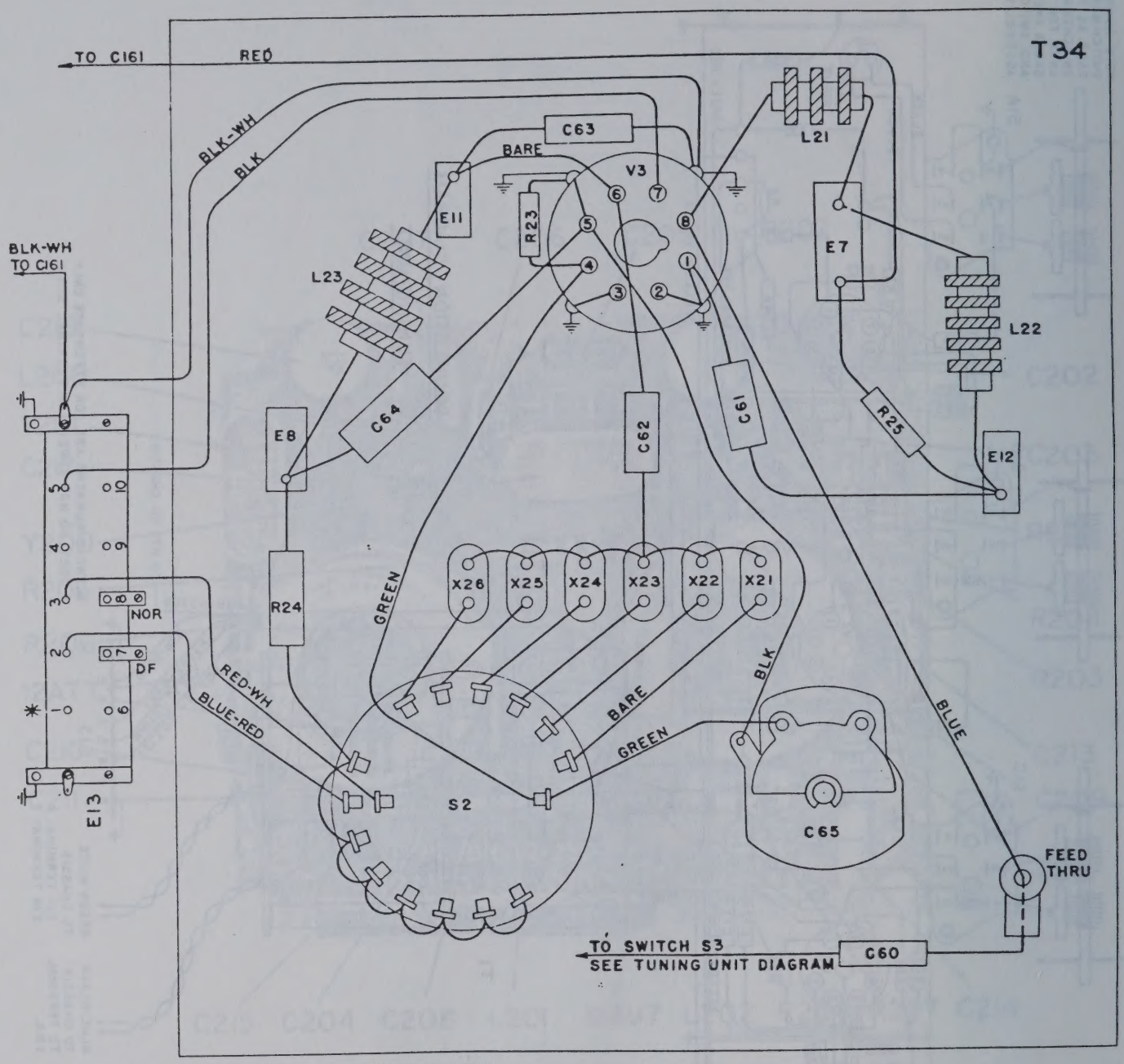


FIG. 12

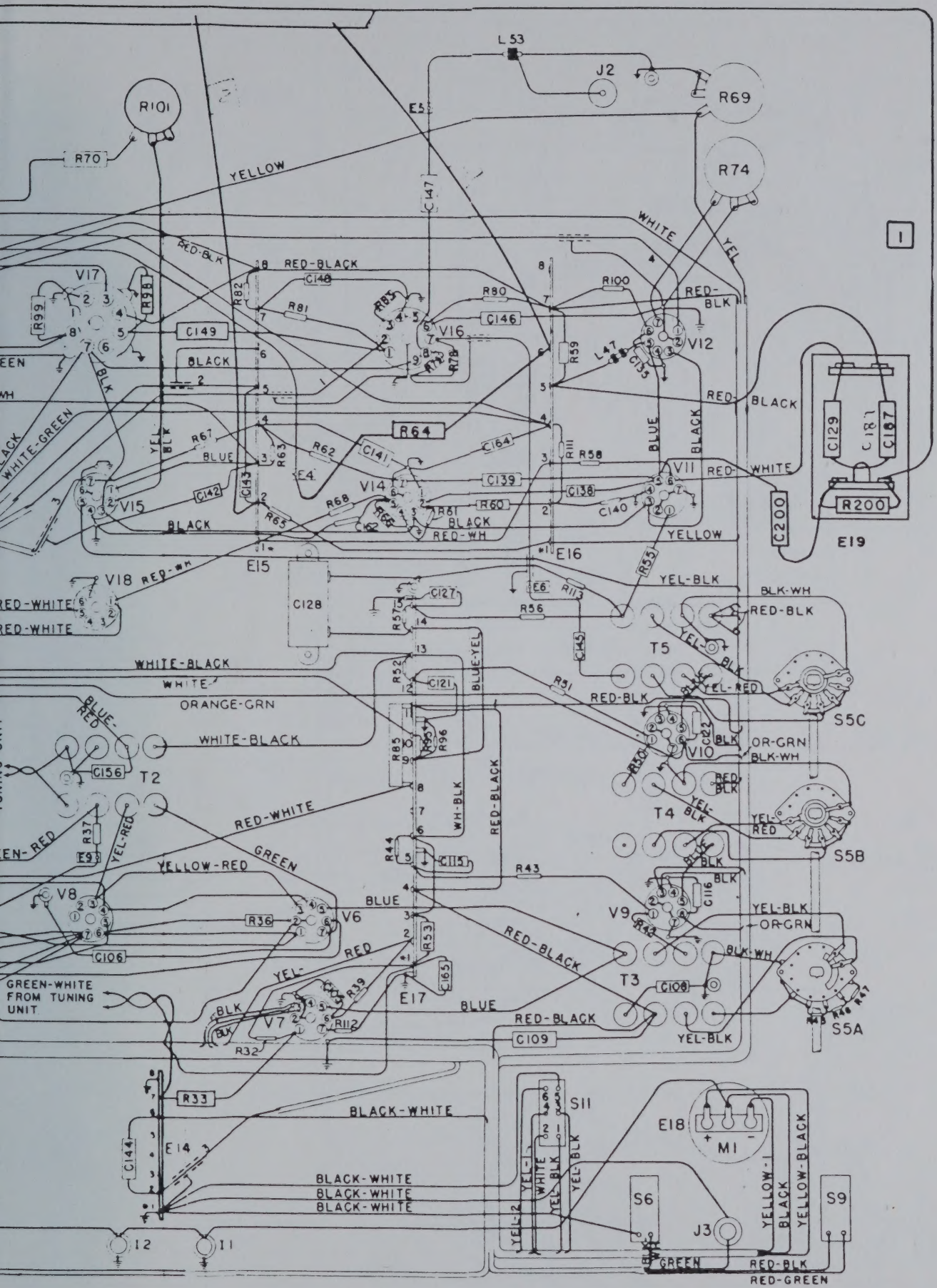
CONNECTION DIAGRAM
TUNING UNIT



* THESE NUMBERS ARE FOR REFERENCE ONLY.
THEY DO NOT APPEAR ON TERMINAL STRIP.

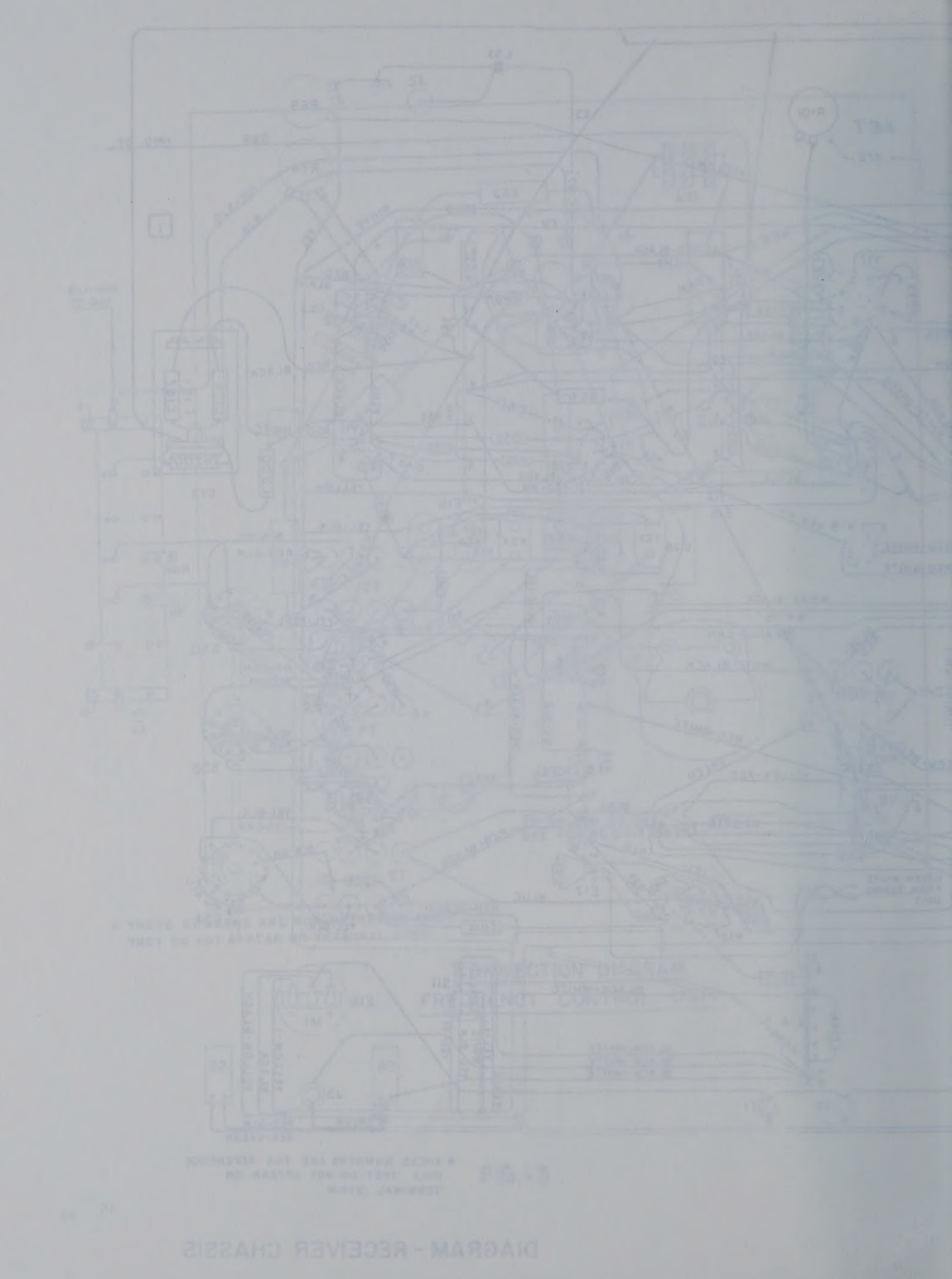
CONNECTION DIAGRAM
FREQUENCY CONTROL UNIT

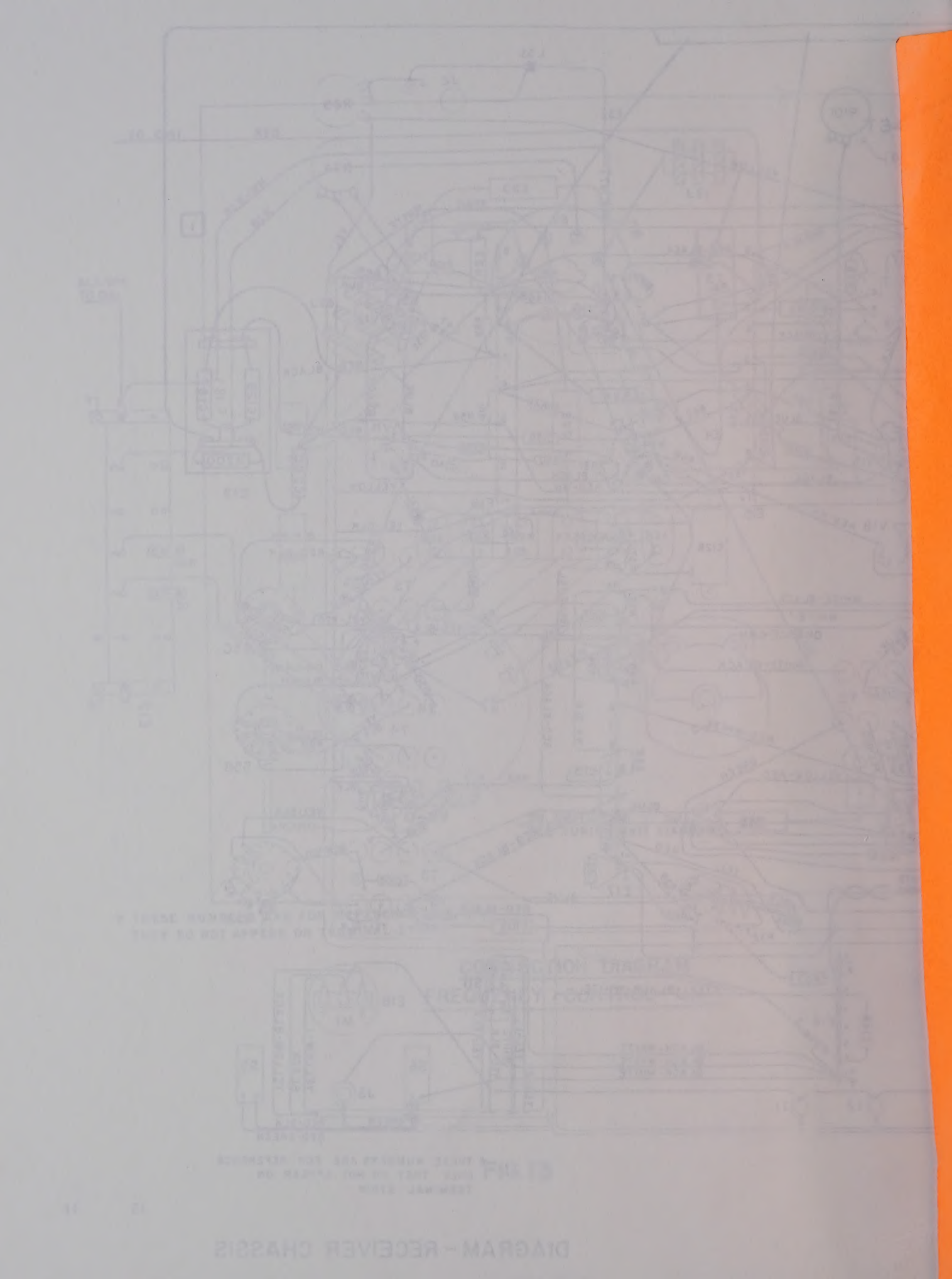
FIG. 13



* THESE NUMBERS ARE FOR REFERENCE ONLY. THEY DO NOT APPEAR ON TERMINAL STRIP.

DIAGRAM - RECEIVER CHASSIS





[1] NUMBERED RG174/U CABLES

PRODUCT DETECTOR WIRING HARNESS

S200 REAR DECK

S200 FRONT DECK

MAIN WIRING CABLE

NOTE: SWITCH IS MOUNTED ON TUNING UNIT OPERATED BY BANDSWITCH
2-3 CLOSED BELOW 7.4 MC
1-2 CLOSED ABOVE 7.4 MC

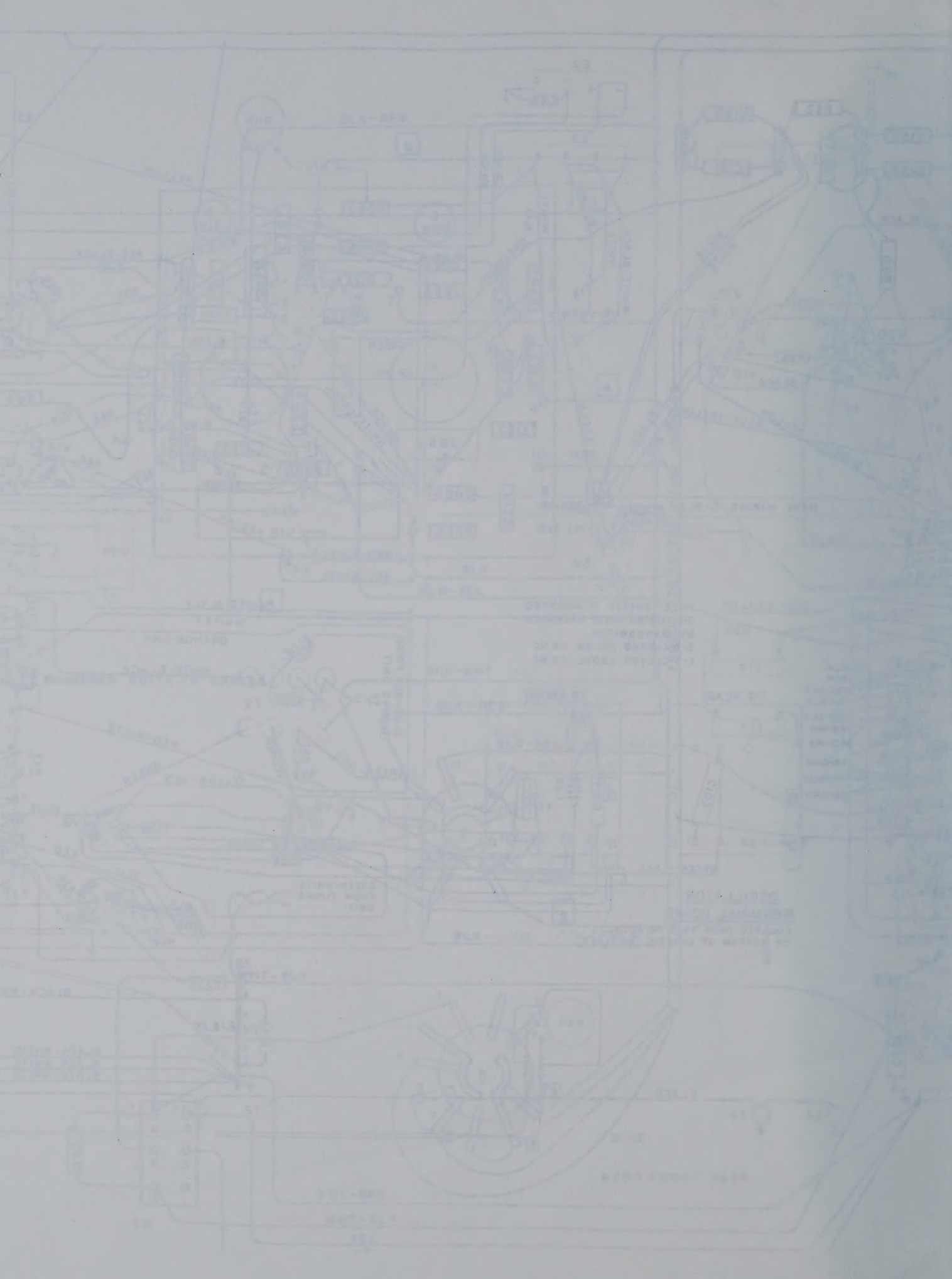
OSCILLATOR TERMINAL BOARD
LOCATED OVER V8 & V6 SOCKETS ON BOTTOM OF CHASSIS. SHIELDED

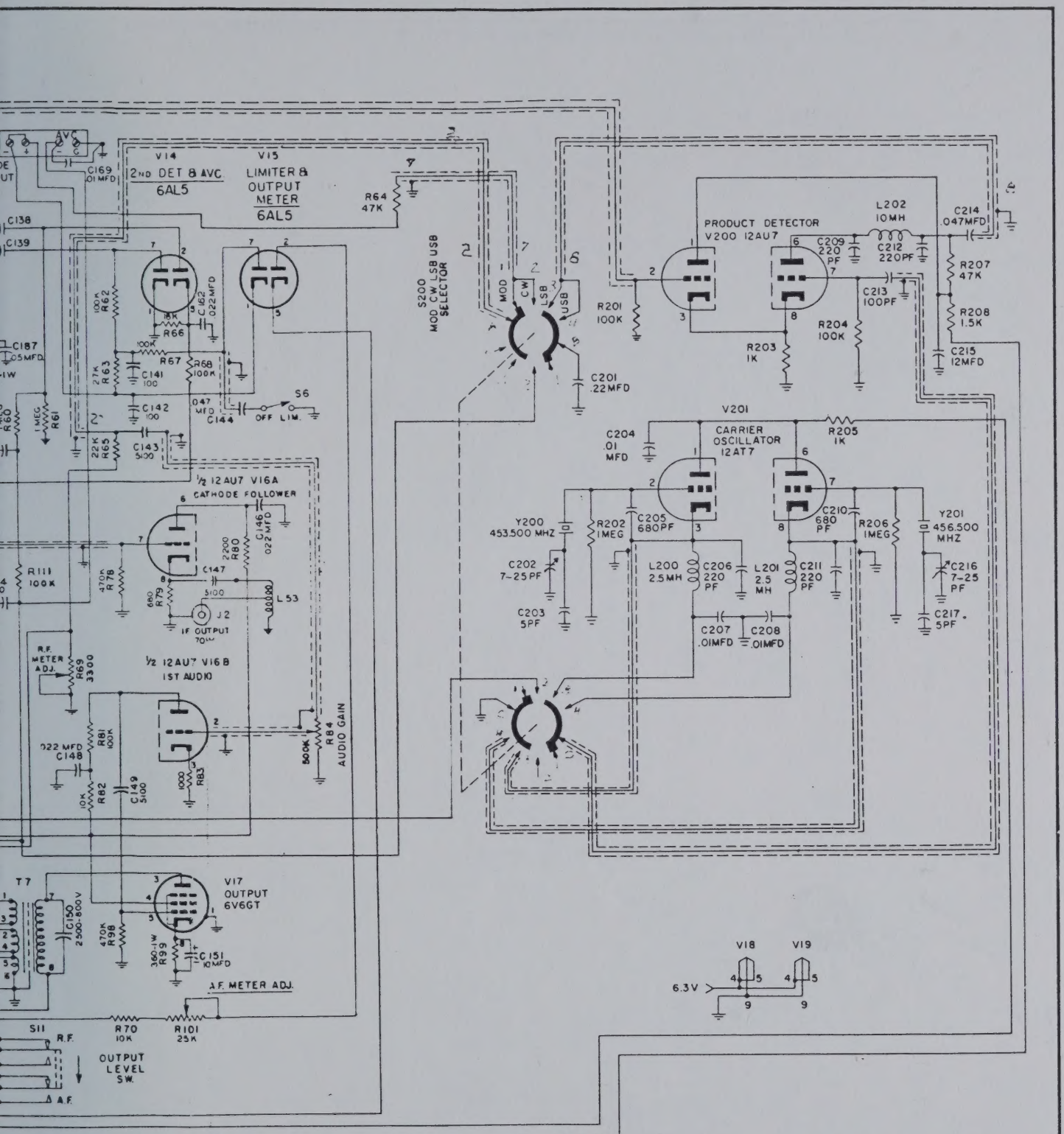
T9 REAR

T9 FRONT

BLUE-BLK FROM TUNING UNIT

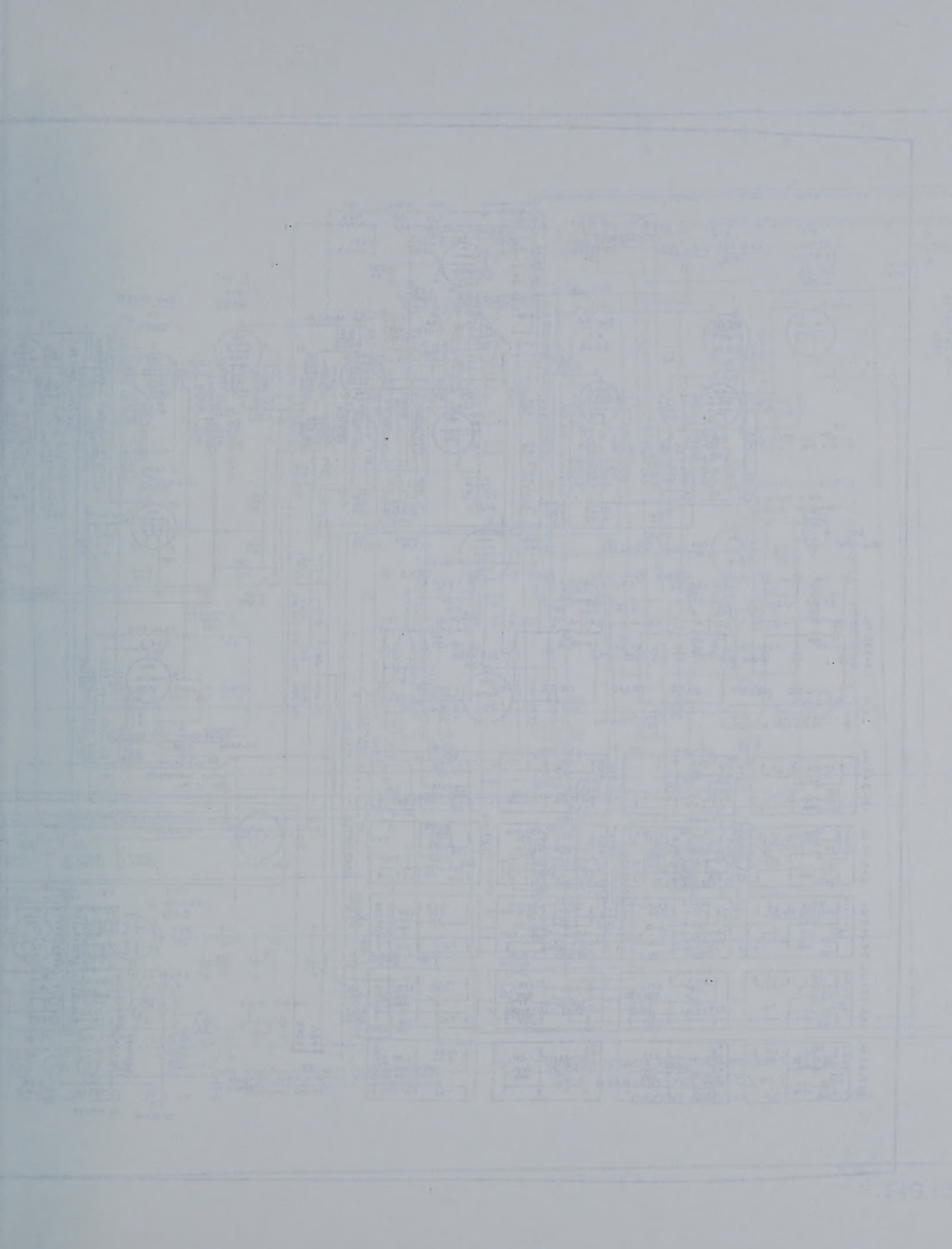
GREEN-WHITE FROM TUNING UNIT

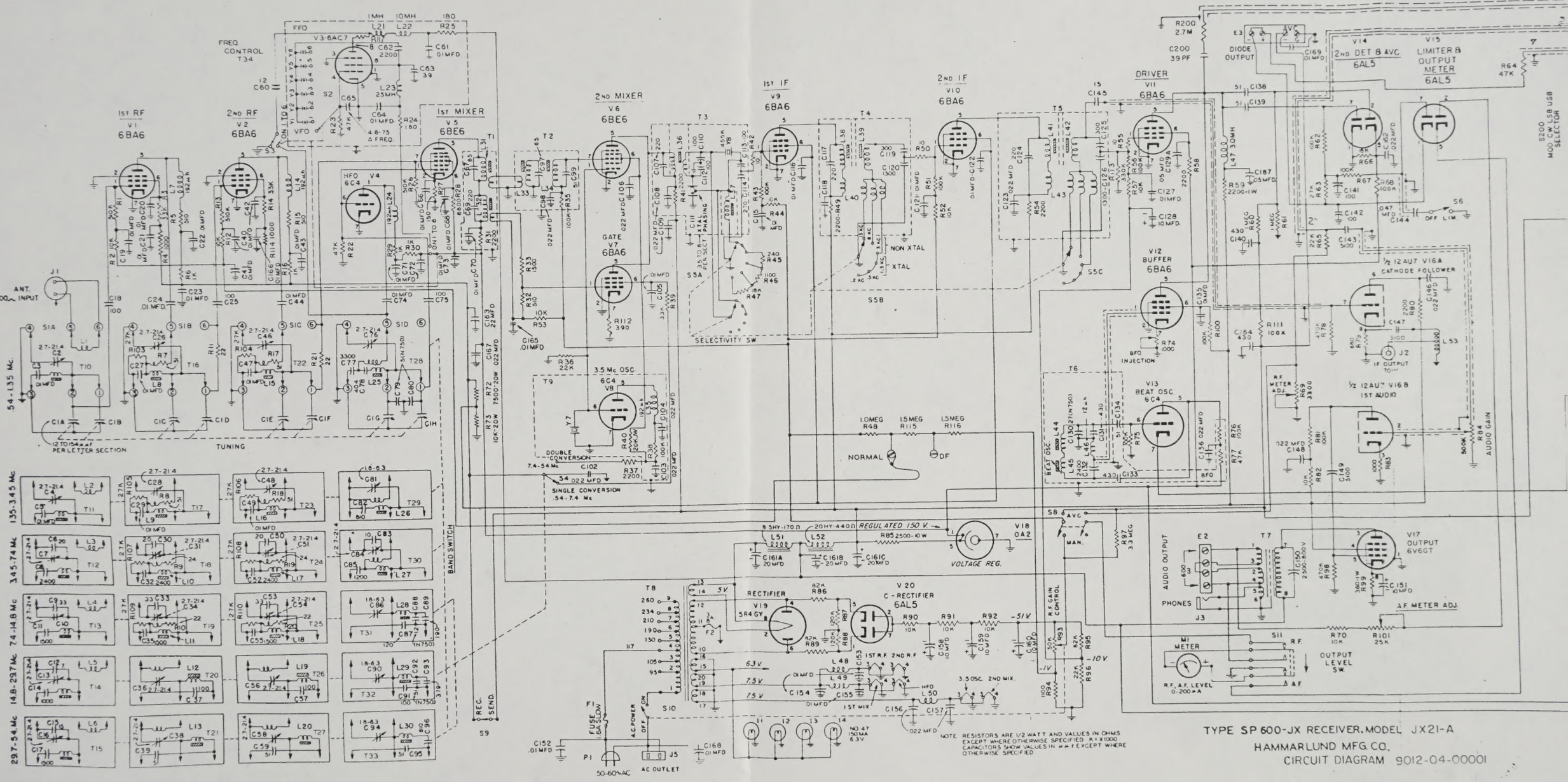




P 600-JX RECEIVER, MODEL JX21-A
HAMMARLUND MFG. CO.
CIRCUIT DIAGRAM 9012-04-00001

FIG. 15 CIRCUIT DIAGRAM OF RECEIVER





TYPE SP 600-JX RECEIVER, MODEL JX21-A
HAMMARLUND MFG. CO.
CIRCUIT DIAGRAM 9012-04-00001

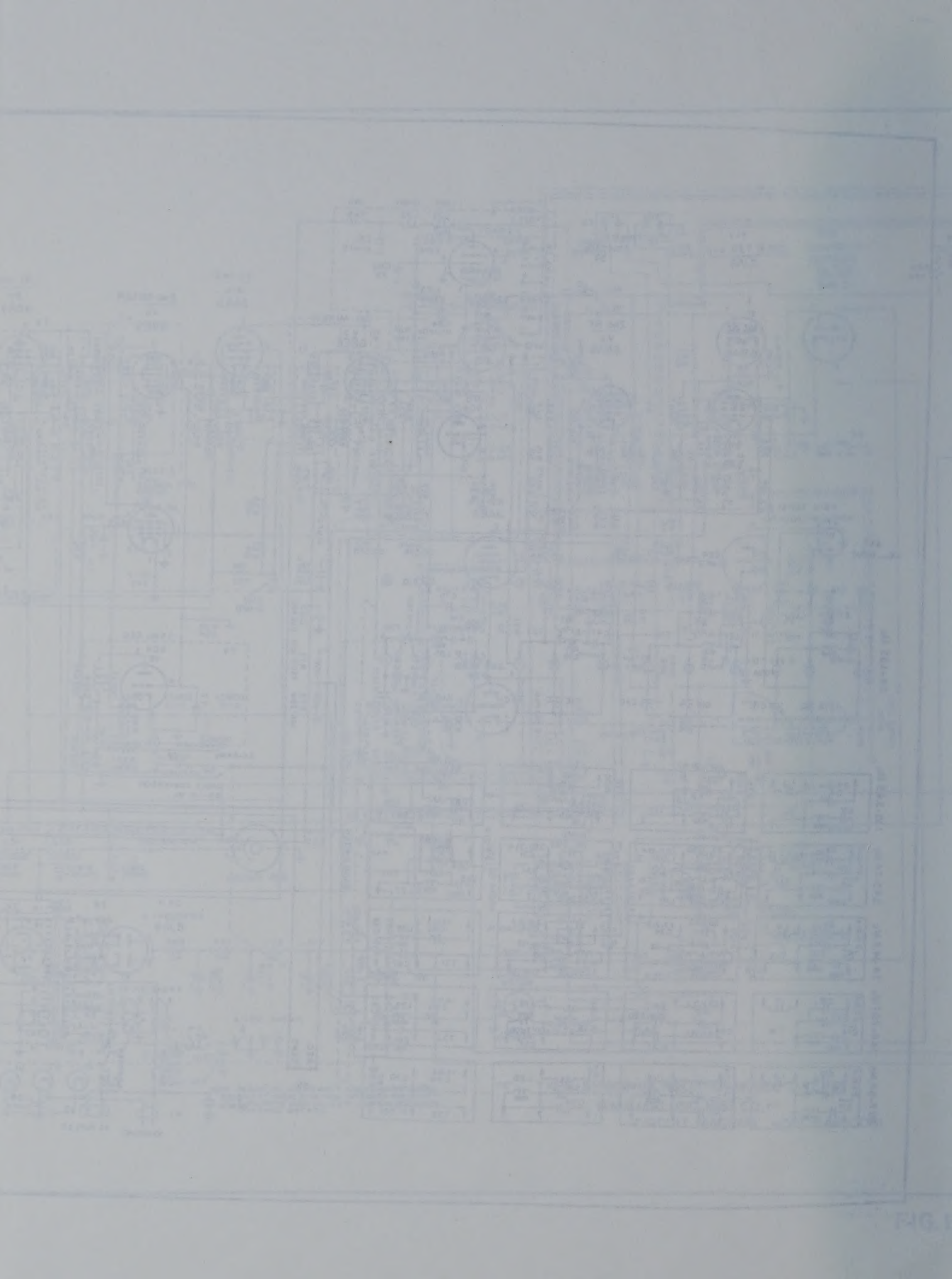



FIG. 15